INTERNATIONAL

MARINE ENGINEERING

Published Monthly by ALDRICH PUBLISHING CO.

6 EAST 39th STREET, NEW YORK — 8 BOUVERIE ST., LONDON, E. C.

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Vol. XXIV — FEBRUARY, 1919 — No. 2

Build Up the Merchant Marine Under Private Ownership

EXCEPT for occasional utterances from Administration circles, scarcely a voice has been raised in favor of Government ownership and control of the American merchant marine. The shipbuilding and shipping interests are unanimously opposed to it. Their opinion is based upon years of experience with the intricate problems involved in building and operating vessels for domestic and foreign commerce, and is further borne out by the experience of most foreign countries in maintaining merchant fleets in competition for the world's trade. In view of this general attitude with regard to the most feasible method of building up and maintaining the American merchant marine, why should further consideration be given to the question of Government ownership? This matter should be definitely settled and plans immediately developed for building up the merchant marine under private ownership.

Raise the Ban on Foreign Contracts

FRANCE is in the market for about 2,000,000 tons of merchant vessels. Great Britain, Italy, Norway and other maritime nations are ready to place contracts for cargo ships wherever the opportunity offers. American shipbuilders, meanwhile, are prevented by an order from the Shipping Board from accepting contracts for vessels from foreign owners. It is true that for the time being American yards are well supplied with work from the Government, but the future, especially for the newer yards, which have been constructed solely for carrying out Government contracts, is clouded with uncertainty. With the probability that Government orders will be curtailed to a certain extent, there is every reason for giving American yards the opportunity to secure foreign business and keep their plants occupied to maximum capacity for months to come. It is only by operating at full capacity that these yards can keep up the high standard of efficiency necessary to reduce the cost of production.

A Way to Meet Competition

IN a recent statement, Edwin C. Bennett, vice-president and general manager of the Newburgh Shipyards, says that in order to stay in business the American shipbuilders will have to come down to a competitive basis with the yards of Great Britain, and this can only be accomplished by one of three ways: First, to reduce the rates of labor as compared with those of Great Britain; second, to increase the output and efficiency of every man in the shipyards; third, to receive a subsidy from the Government. The most acceptable solution of this problem, he holds, is by the increase of output and efficiency of the men working in the yards. If the shipyard workers of America will turn out 33⅓ percent more work per day than the men in British yards, then the shipyards in America can hope to retain the present high standard of wages and yet compete successfully with the shipyards of Great Britain.

This solution of the problem puts the matter entirely up to the shipyard executives, workmen leaders and foremen. It is sound advice and should be carefully heeded by the men in every American shipyard. During the last year the yards on the Great Lakes turned out more tonnage per man than any other district in the country. Their work has been developed along the line of increasing the efficiency of the individual workers, and the results have been substantial and gratifying. This lesson could be more generally applied with profit.

Council of the Naval Architects' Society

LITTLE appreciation of the changed situation in the marine field is shown by the Society of Naval Architects and Marine Engineers in electing to its Council anyone who is not intimately associated with the building or operating of ships. In previous years, when shipbuilding was of less consequence, if it seemed desirable to elect certain members to the Council out of courtesy, little harm was done, but in these days, when the country is establishing a big merchant marine, the management of the Society should be in the hands of the most competent men available. The time has come when the Society should make its influence felt in laying out broad policies for the building up and maintenance of the merchant marine created by the war, and if the Society is going to do the work that it will be called upon to do, and do it efficiently, a radical change in policy will be necessary.

American Ships Built In 1918

DURING the calendar year 1918, American shipyards built 1,882 merchant vessel of 2,721,281 gross tons, as officially numbered by the Bureau of Navigation, Department of Commerce, including a small amount of tonnage built for the French Government. As compared with an output of 1,699 merchant vessels of 1,034,296 gross tons from American shipyards in 1917, a gain is shown of 1,686,985 gross tons, or nearly 165 percent for the year.

The seagoing tonnage for 1918 totaled 821 vessels of 2,597,026 gross tons. Of this, 460 vessels of 1,861,321 gross tons were steel steamships, the remainder being of wood. The non-seagoing vessels totaled 1,061 of 121,255 gross tons.

When the armistice was signed on November 11, American yards were approaching an average monthly output of 400,000 gross tons, including vessels which the fabricating yards were just beginning to produce in quantity. The cessation of hostilities, however, led to an appreciable reduction of effort through reduced overtime, canceled contracts and like incidents.

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Lloyd's Report on World Shipbuilding

MERCHANT vessels under construction throughout the world at the end of September aggregated 6,371,388 gross tons. This includes 1,966 steam vessels of 6,258,194 tons and 178 sailing vessels of 113,194 tons. The figures are furnished by Lloyd's Register of Shipping for the quarter ended September 30.

The returns, which take into account only merchant vessels in course of construction in the United Kingdom, the British Dominions and allied and neutral countries of 100 tons and upwards, the construction of which has actually begun, show that there were 383 merchant vessels of 1,746,933 tons gross under construction in the United Kingdom at the close of the quarter ended September 30.

Economical Ships Will Win

DURING the war all efforts in the shipyards were directed to speeding up production and getting out the greatest amount of tonnage in the shortest possible time. Questions of economy of operation of the vessels were very properly made secondary to rapid construction, adequate supply of materials and manufacturing capacity, reliability of operation, maximum speed and carrying capacity. To gain these ends something was necessarily sacrificed in the economy of operation and durability of the vessels. The result has been that a part, at least, of the emergency fleet created by the war consists of vessels which, in efficiency and economy of operation, do not compare favorably with the merchant vessels of other nations.

These statements are not made with the object of criticising the work of the Emergency Fleet Corporation or of American shipbuilders, for criticism of what has been accomplished during such an emergency is, in our opinion, unjustifiable. The object of building the emergency fleet was to get our troops and their supplies to the front in the shortest possible time. The effort was honestly made, and if it failed in some particulars the results more than justified the attempt. The moral effect of the effort to build a bridge of ships across the Atlantic had a far-reaching influence upon our Allies, upon ourselves and upon Germany. The ends justified the means and the results speak for themselves.

But with the return of peace entirely different conditions affect the building of ships. From now on shipbuilders and shipowners will have to contend with world-wide competition in building and operating vessels. Legal restrictions and adverse legislation cannot be overcome by improved ship design; a revision of the navigation laws and a change in Government policy regarding shipping will be necessary for that. But when these obstacles are removed the fact remains that, other things being equal, the success of American ships in competition with foreign vessels will depend upon the ability to operate these ships as economically from an engineering standpoint as the ships under foreign flags.

This puts the success of American shipping squarely up to the naval architects and marine engineers. Figured on a basis of fuel consumption, speed and deadweight carrying capacity, American vessels must hold their own against the best of the world's shipping. The chairman of the Shipping Board realizes this, and in recent addresses has emphasized the need for giving greater consideration to the question of economy in operation of vessels rather than to speed of construction. Further than this, the Shipping Board has already appointed a committee of men identified with large and successful shipping enterprises to examine the building plans of the Emergency Fleet Corporation to consider what revisions of types of vessels are advisable and what modifications of plan or practice can be undertaken to give the Fleet Corporation's output of ships as high an economic value in world trade as possible.

As something like 20,000,000 tons of coal will be required annually for operating the new emergency fleet, it is of vital importance that this item of operating cost be materially reduced. Again, the reports of machinery trouble on the emergency vessels which have been current in recent months show that there is an opportunity for both naval architects and marine engineers to attack the situation in earnest and assume the authority that is theirs by right to control specifications and construction details. From now on, economical operation of the ships should, and must, be required from those in authority. The excuse will no longer be valid that lack of time or material prevents attaining satisfactory operating economies.

Belfast's Extraordinary Shipbuilding Records

WHEN British shipowners were told that shipbuilders in Belfast are building standardized ships in half the time required by shipbuilders in England or Scotland, the shipping fraternity rubbed its eyes in amazement. The Ulster capital, it seems, completes a standardized ship in twenty-four weeks from the time the keel is laid, whereas Stockton requires forty-one weeks, South Shields and Hull forty-four, Sunderland forty-seven and forty-eight, and Glasgow fifty-four and fifty-five. If the difference were a matter of only a week or two as compared with the time required in the Clyde yards, it might be accounted for in several ways, but when Belfast shipbuilders are turning out the work in half the time of their competitors, there must be some unusual reason to account for it.

First of all, there is no conscription in Ireland. The Belfast yards have even more labor than before the war. On the other hand, on the Clyde, Tyne, Tees and other British rivers there has been a veritable famine of skilled labor. Some of the best men have been in the army, and extraordinary inducements have failed to lure them from the tenacious clutches of the War Office.

A good many people have also jumped to the conclusion that either Belfast workmen must be extremely industrious or that the shipyard workers on the Clyde and Tyne are not doing their best. Of course the figures prove nothing of the kind. But it would be interesting to learn in connection with the work in the Belfast yards how much preliminary work is being done on the ground before the keel is laid. Firms with plenty of space and ample supplies of labor do more preparation on the ground than firms short of space and labor can do.

Then, again, the question of cost arises. The four features determining the cost of a ship to the purchaser are: Material, labor, establishment charges and profits. One would expect that Belfast, with its accelerated output, would be building these ships more cheaply than any of its competitors. But this is not so, the reason alleged being that its labor is more costly per ship. As a matter of fact, the North East of England builds cargo vessels, standardized or otherwise, more cheaply than any other shipbuilding center.

Taking all things into consideration, perhaps it is not so surprising that yards which can keep their organization intact, retain their own workers, pay good wages and provide facilities for completing much of the work before the erection of the vessel is begun can make an unusual

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showing in quick deliveries. The Belfast yards, apparently, have been fortunate in many respects at a time when others have had extraordinary difficulties to overcome.

The Wooden Emergency Fleet

CHARGES recently made in the Senate, to the effect that the wood ship programme of the Shipping Board has been a complete failure and that all money invested in these vessels will be a dead loss to the Government, have brought out a statement from James O. Heyworth, manager of the Wood Ship Division of the Emergency Fleet Corporation, which summarizes the progress in the construction of the wood ships and gives some idea of the results obtained in their operation. Measured by performance, which includes vessels under way as well as vessels delivered, Mr. Heyworth asserts that the entire wood shipbuilding programme has shown an efficiency of 72½ percent. Up to December 1, 101 wooden ships had been completed, of which 94 are in active service. Facts are now available concerning the movement of 85 of these vessels. In all, they have made 305 voyages covering a total of 490,422 statute miles. The record shows that 194 of these voyages were with cargo, representing a freight movement of approximately 485,000 tons, a total mileage of 391,092 statute miles. The vessels have been active in the Atlantic and Pacific coastwise trade, they have traveled to the Hawaiian and Philippine Islands, to South America and to Africa. This movement of cargo has been accomplished with substantially no loss to the shippers. It has thus been demonstrated that the vessels of the wooden fleet have rendered valuable service in both coastwise and trans-oceanic runs.

As to the many rumors of general failure of this type of ship and the specific charges made in the Senate, Mr. Heyworth declares that the Emergency Fleet Corporation has a wealth of evidence on hand concerning the staunchness and seaworthiness of these vessels—evidence that is sufficient in volume and character to emphatically disprove any rumors of general failure on the part of the wooden fleet. It is true that expectations as to deliveries were not met. Delays occurred from the start; first, in preparing the designs of the vessels; second, in securing materials; third, in equipping the yards, and fourth, in securing the machinery and fitting out the vessels. Other handicaps included poor railroad service, bad housing conditions and inexperience among contractors. But in spite of these delays the output of wood ships proved sufficient in amount and early enough in time of delivery to be a factor in solving the transportation problems of the war. Taking all things into consideration, Mr. Heyworth believes the construction of wooden ships was justified both by the conditions existing when the wood ship programme was decided upon and also by the account which these vessels have given of themselves in actual service.

Of the troubles experienced with the ships in operation, 90 percent were of a minor character, according to Mr. Heyworth's statement, and of these one-half were probably due to inexperienced crews or faulty handling. In refutation of the charge made in the Senate that "none of the wood vessels delivered has yet gone overseas because none is fit to go," the fact is cited that the wooden vessels of the Emergency Fleet carried substantially an entire sugar crop from the Hawaiian Islands in 1918 without any greater damage to this highly perishable cargo than is sustained in steel ships. Practically all of the canned goods originating in the Islands have been transported to the American Pacific and Atlantic coast ports with similar results. In order to eliminate so far as possible the minor mishaps on the newly-built wooden vessels, 24-hour deep-sea trials of all new wooden steamers were inaugurated by the Government officials in the Oregon district in the latter part of November. Before entering on their 24-hour sea trials the vessels are put through a dock trial and then taken out for a 6-hour run in sheltered waters, so that by the time they go to sea for the final test the necessary adjustments have been made and the vessels can be promptly released for commercial purposes. At the present time the Shipping Board is ready to charter its wooden steamers on time charter for service within approved limits.

Help Place Army and Navy Officers and Men in Civilian Trades and Professions

AMERICA'S greatest assets, the brain power and energy of her thoroughly trained young men, are the commodities in which the professional division of the United States Employment Service are now dealing. Officers and men of the Army and Navy released from active service are being registered with the division and placed in touch with those employers who can best make use of their services.

This division deals only with those men who are well equipped by education and experience in their particular lines of work. The record of each man is carefully investigated before registration is permitted. Many university graduates in mechanical, electrical and civil engineering, and in chemistry, and other technical men with several years of practical experience, have already been registered. These men who willingly severed their business relations more than a year ago to give their services to their country are returning to civil life to find changed conditions.

Although the industry of the country has great need of their services, neither men nor employers are able, without assistance, to discover each other immediately. To avoid delay in the readjustment processes, not only the labor of the country but also the highly trained directors of industry must be mobilized. The aim is that each man shall fit into that part of our business organization in which he can do his best work.

The task of dealing with thoroughly trained men who, in many instances, can command high-salaried positions requires the assistance of those technical organizations which have heretofore placed university graduates and experienced men with employers. The professional division, therefore, is seeking to co-operate with all such societies by referring properly qualified men to them or by obtaining from them data on positions available.

The technical engineering field appears to present the largest problems of the professional division, since thus far nearly one-half of all the applicants have been qualified for work in various forms of the engineering profession. Temporary lull in general construction work has in part closed one field which, it is believed, will be more available by the time the overseas forces begin demobilization on a large scale.

At the professional division of the United States Employment Service, with New York office at 16 East 42nd Street, registrations of experienced men are increasing. Employers seeking such men are asked to inform the professional division of the precise nature of the positions which they have available. Only those men who are well qualified to fill such positions are referred to the employer.

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Standardization in Shipbuilding

IN the efforts of the British Government to cope with the urgent need for an increased output of shipping, the standardization of the auxiliary and propelling machinery for merchant ships naturally followed upon the adoption of the policy of building standard hulls. It was considered that the best method of securing rapid output was to adopt the tried design of firms accustomed to producing the merchant ship class of machinery and to appoint one firm to act in a leading capacity for each different size of machinery. That is to say, all the designs for each class of engines, with the exception of the small pumps, etc., were prepared by one firm and issued complete to the various machinery contractors, together with a specification of all the raw material and finished items which were to be obtained from sub-contractors.

The drawings and information issued by these leading firms were very complete, much more so than usual, so that even firms who were not familiar with such work would have no difficulty in knowing exactly what was required. In this way the labor in other drawing offices was reduced to a minimum. As all firms are working to one design, it has been arranged in many cases that firms do not make new patterns, but obtain the use of those already made by another firm, thus reducing labor and conserving the special timber required for pattern making. With standardization, materials, such as shafting, auxiliary machinery, pumps, valves, fittings and piping, can all be manufactured in large quantities and thus the fullest advantage taken of duplication and of the available reserve in plant and labor. Moreover, in the event of a firm falling behind with the construction of machinery for a particular hull, a replace set can easily be transferred from another source. The delay in completion that must have been incurred had each builder been building to his own designs and sizes is therefore avoided.

The first size of machinery adopted was capable of developing about 2,500 indicated horsepower under normal conditions, and about 3,000 horsepower for a short period in an emergency. The standard designs adopted were prepared and issued to the machinery contractors within a few weeks after the instructions were issued to the leading firms, and the first vessel fitted with standard engines was ready for sea eight months after the order for her was placed. The programme has now been extended to include larger vessels with greater power, and also smaller vessels down to the coaster size. Even so, however, the number of different types of engines constructed has been kept down to the minimum. They do not exceed half a dozen.

Experience has now proved the very real advantages of standardized machinery. For instance, engines and boilers have frequently been transferred from one firm to another, in order to expedite delivery. Again, in many cases where engines and boilers have been damaged by enemy action in the war they have been replaced without loss of time by standard engines and boilers ready to hand, thus greatly expediting the completion of repairs, which would have taken longer if it had been necessary to await the construction of a new engine and boilers. In many cases, too, a part of an engine has been sent from one firm to another to expedite the completion of a particular set of machinery.

Another very great advantage accrues from the standardization of the smaller parts of machinery. As each of them is reproduced without the slightest variation, the sub-contractors can work continuously and produce them in large numbers. There is, therefore, no delay in delivery when they are needed, whereas with the old methods, although such parts differed only in very small points, to suit the needs of individuals the difference was sufficient to prevent their use for the first firm requiring delivery.

Perhaps one of the most important advantages of the standardization of merchant ship engines is that it has enabled the labor and equipment of a number of inland firms to be utilized in a manner which would not otherwise have been possible.

LETTER TO THE EDITOR

Analysis of Shipyards Organization

In reply to Mr. Frederick Thorne Warner's letter in the January issue on "Analysis of Shipyards Organization," I will take up the points in his letter in the order in which they occur.

The pipefitters should be under the machinery superintendent, as pointed out by Mr. Warner, and in addition to this change I would put the riggers under the hull superintendent and not under the machinery superintendent as they appeared in my first article.

The painters under the plant engineer were put there deliberately, and there is no reason why they should be confused with the ship painters.

On the schedule of information called for by the Emergency Fleet Corporation from prospective contractors, plant facilities for producing work are put ahead of housing problems for the men. Therefore it seems to me a debatable question whether "social entertainments" for workers should be called one of the more important functions in the "service or industrial relations" department, when this department is called by Mr. Warner "the most important department in modern shipyards."

The "superintendents' department" was not omitted from my article, as Mr. Warner insinuated. This department was mentioned in my summary and conclusion on page 617 of the November, 1918, issue of this magazine.

The duties of the chief engineer and the naval architect have, to the best of my knowledge, never been successfully combined. Each man should be a specialist in his own branch, and naval architecture and marine engineering are two very different branches of engineering.

I do not believe that the plant engineer should be put under the general superintendent of ship construction. At least it is not customary to do so in the old-established shipyards of the country where the present organization and work is based on twenty or more years of practical experience in the economic production of ships.

Under the heading "General," I have been criticised for having too many departments and too many divisions under departments. It is well known in logical reasoning and logical analysis that facts are most readily and most surely arrived at by division and subdivision until finally a point is reached where no further division is possible. If this method of analysis is followed out, as was done in my article, a great many of the mistakes that occur may be avoided and the shifting of responsibility for mistakes by the guilty department to some other department may be quickly detected and dealt with.

As there are several department heads who manage their own departments, as mentioned in my article, I fail to see where my reasoning was wrong in putting a general manager at the head of my organization.

Mobile, Ala. G. F. S. MANN, B. S.

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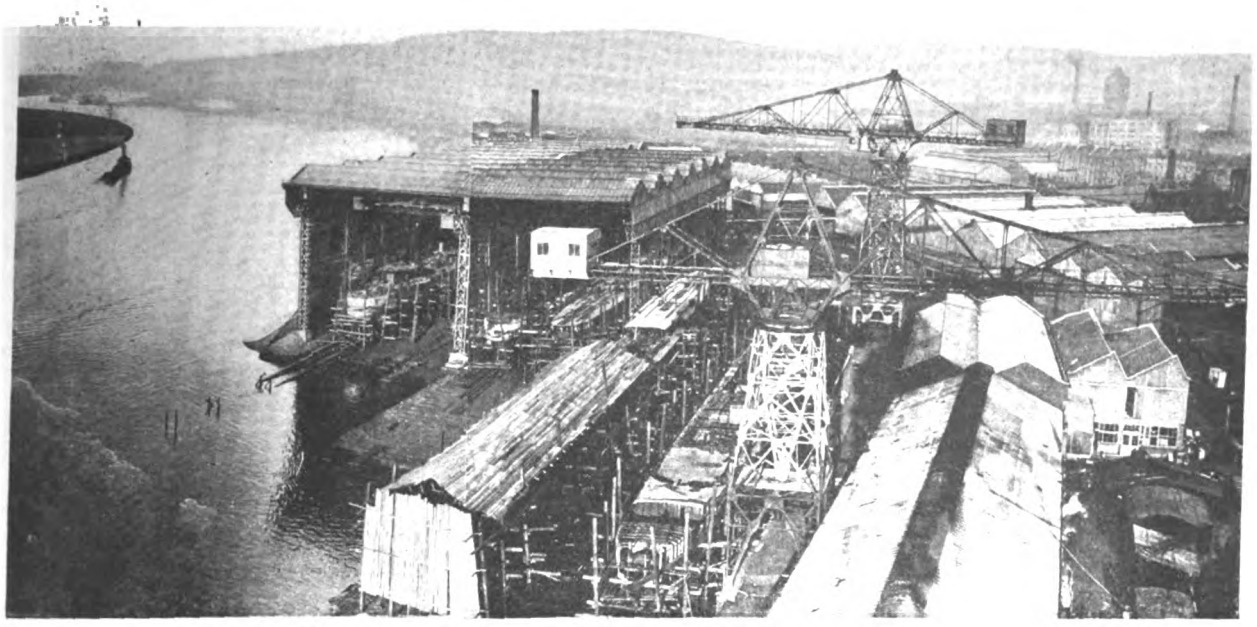

Fig. 1.—A British Shipyard Viewed from One of the Cranes

Some Things I Saw and Heard in England and France

BY H. L. ALDRICH*

FIFTEEN publishers and editors of leading American technical and trade journals received formal invitations from the British Ministry of Information to visit England and the battlefields of France as guests of the British government. The invitations were dated October 16, and the writer had the honor of being selected to represent shipbuilding and shipowning interests.

What made the invitations a very special honor is the fact that hardly more than fifty civilians in all the allied countries have seen, heard and experienced as much regarding the great war as this wonderful opportunity enabled us to do during these many eventful weeks. Neither in the invitation, nor in any subsequent communication, did we receive any definite explanation from the British government, or its representatives, as to why we were invited; nor any hint whatever as to what it desired us to state or publish about the trip on our return. We can only surmise that the hope and expectation was that we had but to observe at first hand the actual conditions to realize and to testify that continued and unbroken friendly relations between America and England are necessary to guarantee a lasting peace.

Cordiality of the British

While in England we were entertained with the greatest of courtesy, and presented to many of the eminent men. In the twelve visits that the writer has paid to England, he has never found the Britishers more cordial in their manner, nor more eager to have the relations between America and England as close as possible. At the many dinners, luncheons and receptions, English speakers expressed the warmest admiration for America and its institutions and the keenest appreciation of this country having come into the war, and having done its part in helping to end it.

It was apparent to us that the English people are exceedingly anxious about two things: First, the building of so many ships here leads the Britishers to feel that possibly America may be England's rival as a shipbuilding and a ship-operating nation; second, the loss of such a large proportion of their valuable men by the war, coupled with the enormous taxation, causes the fear that England may fall to the second position as an exporting nation. In talking with representatives of the government and of the great industries, and in visiting the shipbuilding center on the Clyde, I came to the conclusion that it is not improbable that America will become the great builder of merchant vessels for carrying the trade of the world from now on. This is possible because of our facilities for building ships, our freedom from enormously burdensome taxation, our cheaper materials, and our methods of "manufacturing" ships. But when it comes to great passenger vessels, there seems to be little doubt but that England will hold the lead in this direction.

So far as the export trade is concerned, I doubt if England will slip back to any great extent in her command of the foreign trade of the world, because she realizes the great importance of straining every effort to get her industries running at once in order to furnish employment for the working people. These industries will feel for some time the loss of many expert men by the war, but we learned that women are doing excellent work in nearly all branches of engineering. Certainly there is plenty of room in the world for two great shipbuilding nations, as well as for two great nations each bidding for the foreign trade, and any competition there may be between the two English-speaking nations will be a far fairer competition, and a competition more acceptable to the world that when Germany exercised her overbearing domination.

When I published the first issue of Marine Engineer-

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Fig. 2.—The Harbor of Saint Nazaire

ING in April, 1897, I firmly resolved never to allow any article to appear in its columns that did not appeal directly to the business interests of men connected with the designing, building and operating of vessels, but I feel that here is an occasion when I may venture to deviate slightly, and I use what I have written here as a peg upon which to hang a few statements as to what the members of our party saw and heard when visiting the battlefields of France. Many things have been published, some of which were based on correct information and others merely on hearsay, but I will simply mention some of the things we saw with our own eyes or heard from men whose veracity admits of no doubt.

We visited a score or two of cities and towns that were completely ruined. These include Ypres, Bethune, La Bassee, Albert, Bapaume, Lens, Menin, as well as many smaller towns. In a number of these places there was not a building, nor even a room, where a man could find shelter from the rain. No words can describe the horrible destruction of houses and other buildings which had been reduced to nothing more than a mass of rubbish. We passed a score or so of sites of towns where there was no indication that any town had once been there, excepting that there were big signs announcing that this was the site of such and such a place. Not only had all buildings vanished, but all traces of roads and streets were obliterated.

We passed tens of thousands of acres of land torn up by shell fire, the craters encroaching one upon another, so that it is really dangerous to attempt to walk there for fear of falling into a crater. These craters are usually full of water and of varying depths, most of them being over the head of the tallest of men. Throughout this blasted land there are vast numbers of unexploded shells and the rotting bodies of thousands of dead soldiers.

The general impression seems to be that for several generations this land cannot be utilized, unless for the purpose of planting a special kind of tree, which may help to restore it. The neighborhood of Lens was one of the great coal mining centers of France with a very large population, yet not a building remains that is not beyond reconstruction. Here we saw the most pathetic sights of our trip, such as a young woman and her mother standing in front of a heap of rubbish where there had once been a home. They were holding hands and looking fixedly at this nothingness, with a pitiful expression of hopelessness, as the tears rolled down their faces. The glimpses we had into the core of human anguish tore at our souls even more than did the desolate scenes of devastation.

French Cities in Ruins

In Arras the great cathedral was in ruins, as was also the greater part of the city, only a few houses in the outskirts remaining intact. Around the cathedral and in two of the squares there were signs reading, "This space has been preserved by the French authorities as an historic feature and a permanent memorial."

On the roads we passed thousands of Hun prisoners, many of them quite young, and most of them with sullen, brutal faces.

Fig. 3.—Street Outside of the Cathedral, Arras

Fig. 4.—Ruins of Main Street, Combles

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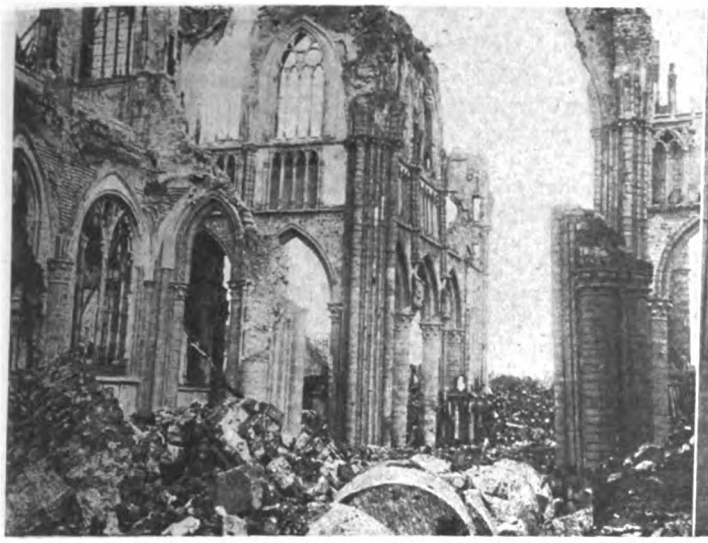

Fig. 5.—Ruined Ypres as it Appears Today. Interior of the Cathedral

Fig. 6.—Interior of Arras Cathedral Taken from the Eastern Altar

One of the many places that showed the cruel and beastly character of the Huns was Douai. This had been a prosperous little city of about 20,000 population. It was in the hands of the Huns up to a few weeks before the armistice. One evening at five o'clock notice was sent out that every man, woman and child must be out of the city before five o'clock the next morning. Then the Huns started in with their characteristic thoroughness and looted apparently every building in the city. I walked for miles in the business and residential streets and there was not a single building where the doors and windows were not smashed. Everywhere we could look in and see pictures slashed beyond repair, and beautiful carved furniture —sideboards, tables, chairs—hacked with hatchets or other sharp implements beyond all possibility of restoration. Portable valuables had been stolen, and everything that could not be carried off had been destroyed.

We went through the house of a well-known representative of the international Red Cross. He was a physician and had one of the finest art collections in Douai. The Huns stole most of his best works of art and destroyed the rest. Also this house, like the others, had been disgustingly befouled by the brutes.

Conditions Among the Survivors

We had a conversation with a most saintly old priest who had remained in Douai all during the occupation. He told us of the shocking things that had happened in the cathedral and elsewhere in the city. He told us how the Huns had robbed his own private chapel of everything worth carrying away and demolished what was left. They even took his sacred vestments, flung them on the floor and befouled them. When the Allied commander discovered the condition of the city he forbade his soldiers to enter it and ordered hordes of Hun prisoners to clean up their own filth.

We were told by a representative of the Red Cross that in a nearby town, just over the border in Belgium, the Huns collected six hundred women in the public square three days after the armistice and stripped them of every article of clothing—even their stockings. These garments they carried off for their women in Germany. Another Red Cross representative, who was a physician, told us that in a nearby Belgian town, before the armistice, the Huns had seized every woman above fifteen to be repeatedly ravished by officers and men. The doctor said that to witness the suffering of these tortured victims was the most terrible experience in his life as a physician.

I talked with many Americans, both officers and men, especially after we reached France. They said that over and over again Huns had forced refugees to pass through a barrage, and many of them were thus killed. I was told by several men of our army who had been in Belgium that they had never personally seen children who had had their hands cut off, but that they had seen many children with great scars across their cheeks, caused by blows from the swords of Hun officers. There are towns where there is scarcely a woman over fifteen who has not been compelled to have a child by a Hun. The terrible treatment of women and children by the Huns is one of the most appalling things in the war; it is in line with their filthy habits and vicious natures. Yet in talking with two captains of the American Army who had been prisoners in Germany, I learned that the Germans resent being called Huns because "the Huns were savages." Our visit to the Hindenburg line was interesting, as it showed us the trenches, as well as the dugouts in which the Huns lived.

The Harbor of Saint Nazaire

As a change from battlefields, I spent a day at St. Nazaire and saw the wonderful work that American engineers have done in developing facilities on an immense scale for handling munitions and supplies of all kinds. What our army has done in France is a revelation, and it has been done by individual initiative and capacity, in spite of the great handicap put upon our officers and men due to incompetence and petty politics at home. Our engineers have done many things that were supposed to be impossible of accomplishment, and in a surprisingly short time. For instance, in St. Nazaire there were no places in which to store supplies. Our engineers, in an amazingly short time, put up 176 warehouses, each 50 by 400 feet, and four more 240 by 500 feet. Along the waterfront we have the finest facilities I have ever seen for handling freight—great numbers of gantry, locomotive and various other kinds of cranes and hoists. I came home prouder than ever of the fact that I am an American.

The battle at Chateau-Thierry, where the American marines and soldiers put up such a valiant fight, showed clearly that the end of the war was near. We have the testimony of many Huns that the collapse of the Hun

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morale at that time was chiefly due to their terror at the accurate markmanship of the American soldiers. When row after row of Hun troops fell before the American well-aimed bullets, the vanquished invaders started on their run back to Berlin, and kept it up until the armistice was signed. Many Hun prisoners declare that they are coming to America as soon as possible after the war. Will Congress take notice of this situation? Our soldiers fear not.

Our soldiers are announcing that when they get home they are going to let the American people know how petty politics and incompetence at home have caused the unnecessary loss of thousands of American soldiers. Almost every officer, as well as soldier, I talked with was exceedingly bitter on this subject.

Excellent Work of American Soldiers

In spite of everything, our soldiers were wonderful! And one of the great outstanding incidents in the war is not only the fact that we managed to put two million men into France in such a short time, but that practically green American soldiers went fearlessly into battle and "licked" the Prussian guards, who considered themselves invincible.

I cannot resist recording the wonderful things officers and soldiers said about the noble work of the Salvation Army men and women, who were everywhere on the battlefields attending to wounded and dying, as oblivious of shot and shell as they would have been of flies. All officers and men also spoke in the very highest terms of the Red Cross.

British and French Saved the World

The world can never give sufficient praise to the British nation for the magnificent manner in which it carried on the Great War for over four years. The Navy saved the Allies from defeat in the early days of the war, and later the Army backed the Navy with true traditional courage. Nor did France fall behind in her duty. These two nations saved the world and kept it worth living in.

Just before leaving London to sail for home, the following letter was addressed to President Wilson, who was then in Paris:

Waldorf Hotel, London, Dec. 19.

Dear Mr. President:

The undersigned American citizens address you to further the sacred cause of human justice and right.

For days we have been passing over the battlefields and through the ruined cities and obliterated villages of Belgium and France. We are among the first American civilians to survey this area of desolation, and we have been profoundly moved.

The devastation and ruin wrought are not the work of one man or a group of men. They are the result of a system the policies of which have been executed with thoroughness by a willing people. The evidences of organized pillage and vandalism are on every hand.

Every law presupposes a penalty for its violation. The laws of nations that civilization has so painfully built up through the centuries have been wantonly violated for four long years. To fail to enforce these laws now would be tacitly to concede the power of repeal by the criminals themselves. These laws must be re-established. To our minds, the enforcement of complete restitution and reparation by the people of Germany and the punishment of the leaders and their guilty agents for the crime committed in violation of existing laws against piracy, murder and pillage will do more than anything else could to ensure that future laws made by agreement of the nations will be observed.

We are writing this to you knowing that the sentiments expressed would receive the support of all Americans could they see these things as we have seen them and hear the terrible evidence from the lips of the unhappy victims.

Henry G. Lord, Boston.
Roger W. Allen, New York.
Arthur J. Baldwin, New York.
H. M. Swetland, New York.
Samuel O. Dunn, Chicago.
Herbert L. Aldrich, New York.
H. Cole Estep, Cleveland.
Harry E. Taylor, New York.
Edward H. Darville, New York.
Howard C. Parmelee, New York.
Frederic F. Cutler, Boston.

New Timekeeping System Smooths Out Difficulties in Pacific Coast Yard

A NEW time-keeping system, said to be the only one in use that gives each worker a daily receipt for his labor, thus obviating disputes, has been successfully put in use at the yard of the Pacific Coast Shipbuilding Company, on Suisun Bay, 35 miles east of San Francisco. The system has reduced pay window disputes 99 per cent, it is declared. It was devised by three of the company's force, L. H. Heacock, T. G. Flynn and L. H. Donnelly. When the plan was adopted the company's payroll was approximately 2,500 men, and has since increased.

The plan is described in the yard's paper, *Full Speed Ahead*, as follows:

"The new H-F-D system of time-keeping, originated by members of this company's staff and in force in the last few weeks, has not only demonstrated its effectiveness in making for accuracy and reducing complaints and disputes to the minimum, but has proven popular with the workers, winning recognition for its fairness.

"The plan was worked out, with much thought and the benefit of long experience, by L. H. Heacock, auditor; T. G. Flynn, counter foreman, and L. H. Donnelly, paymaster.

"The use of the duplicate card system evolved by the originators on a plan followed in no other yard gives a documentary record of time, valuable to the man in the yard or shop and the office, and has reduced errors to one per cent of the old ratio. Arguments and bother are virtually done away with.

"This plant is the only one in existence, it is believed, which has ever given the men a daily receipt for time worked, enabling the men easily to prove any shortage claim, by presenting the daily card, correctly made out.

"The men are given the receipt cards on checking in. Instead of the old-fashioned time keepers, the validating is done by time checkers, who write on each man's card the number of his job. Periods or hours actually worked are indicated by punching in columns provided on the card. The duplicate of each card, with identical markings and punches, gives the office its record.

"At the end of his shift, the employee turns in his half of the double card, keeping the other half for his own record. Those turned in are collected by the office and posted on a card giving the weekly record, which shows the man's full working history for the week, with any deductions.

"If there is a difference of opinion between the employee and the pay window, it is only necessary to put the man's card and the office card together: the punch holes will match and establish the correct record."

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Plans For Hog Island Steel Cargo Ship

Design and Construction of Single-Screw Vessel of 7,500 Tons Deadweight Type—Cargo Space 380,000 Cubic Feet

THE specifications call for a single-screw, steel cargo vessel of the two-deck Type, with bridge, forecastle and poop. The length over all is about 401 feet, and the length at the load waterline 390 feet. The molded beam is 54 feet, the depth to the second deck 23 feet, and to the upper deck 32 feet. At full load displacement the draft is about 24 feet.

The vessel is designed for a deadweight capacity of 7,500 tons, the total displacement loaded being estimated at 11,200 tons. According to estimates, the weight of the steel hull is 3,100 tons; of the machinery with water, 460 tons; of the wood and equipment, 140 tons, and the total weight of the ship, light, 3,700 tons. There are 380,000 cubic feet of cargo space, and the gross tonnage is estimated at 5,400.

Propulsion is by single screw, driven by a geared turbine of 2,500 shaft-horsepower, supplied with steam at 200 pounds per square inch pressure from three oil-fired water-tube boilers, with a total heating surface of 9,075 square feet, operated under natural draft.

The main turbine is designed to operate at 3,600 revolutions per minute, driving the main propeller shaft through a double helical, double reduction gear at a speed of 90 revolutions per minute. With dry saturated steam at 180 pounds gage pressure at the throttle, a 28-inch vacuum referred to a 30-inch barometer in the condenser, the steam consumption of the turbine, when developing its rated horsepower, is guaranteed not to exceed 12 pounds per shaft horsepower. The vessel has a fuel capacity of about 1,100 tons, and, with an estimated fuel consumption

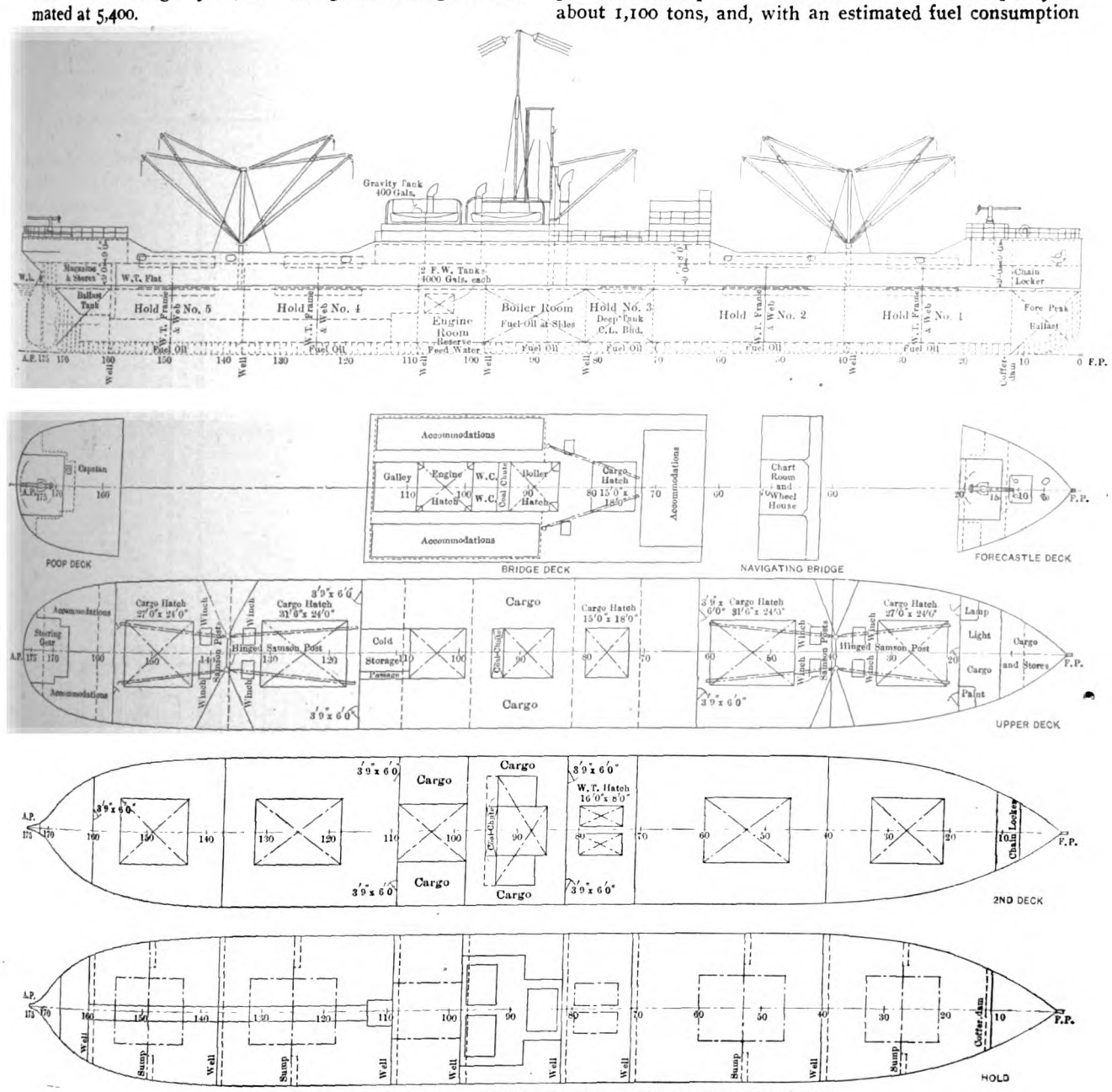

Fig. 1.—Profile and Deck Plans of 7,500-Ton Cargo Ship Built at Hog Island

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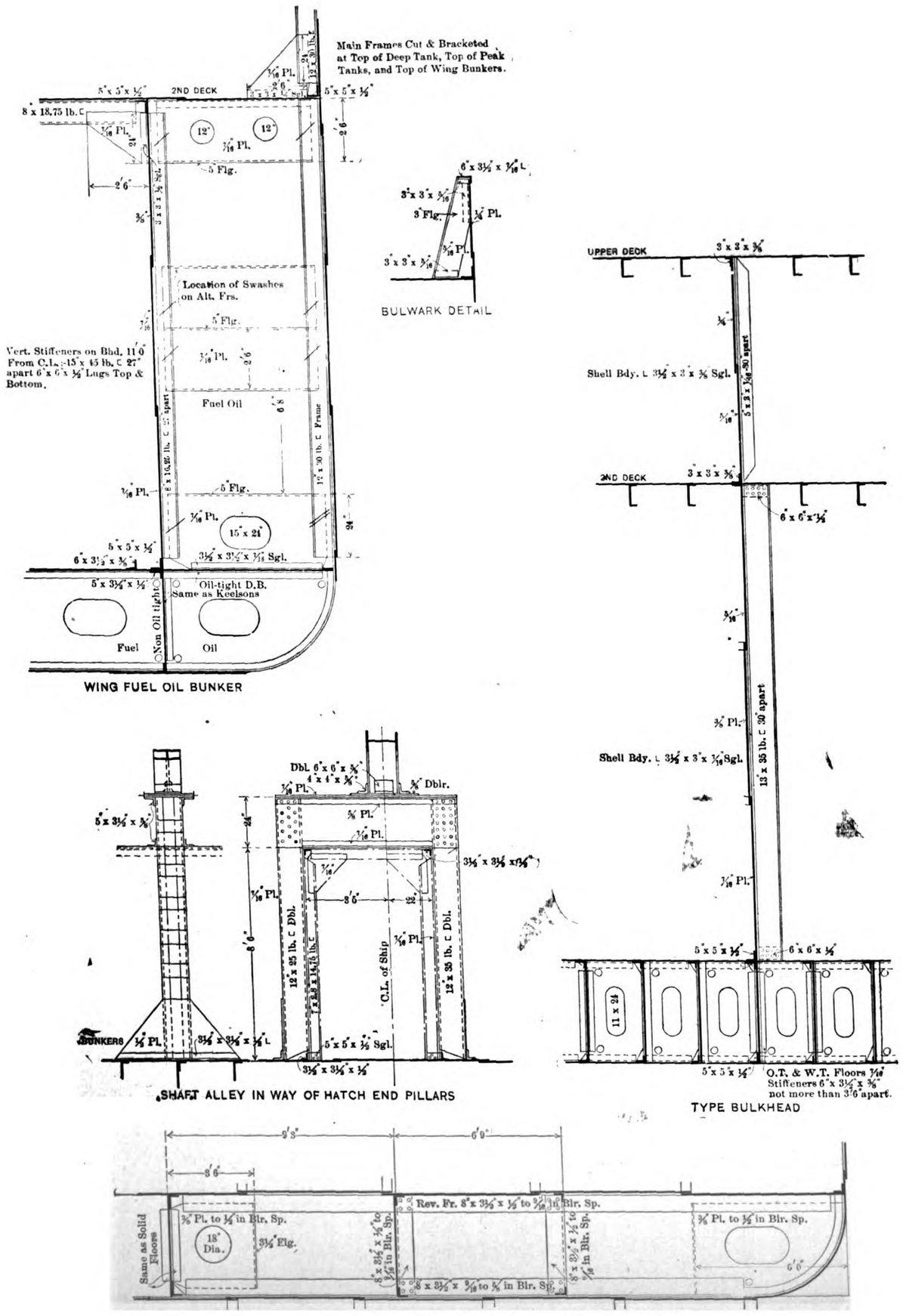
Main Frames Cut & Bracketed at Top of Deep Tank, Top of Peak Tanks, and Top of Wing Bunkers.
2ND DECK
Location of Swashes on Alt. Frs.
Vert. Stiffeners on Bhd. 11'0" From C.L. 15" x 45 lb. C 27" apart 6" x 6" x ½" Lugs Top & Bottom.
Fuel Oil
Oil-tight D.B. Same as Keelsons
Non Oil tight
Fuel
Oil
WING FUEL OIL BUNKER
BULWARK DETAIL
UPPER DECK
2ND DECK
Shell Bdy. L 3½" x 3" x ⅜ Sgl.
13" x 35 lb. C 30" apart
Shell Bdy. L 3½" x 3" x 7/16 Sgl.
O.T. & W.T. Floors 7/16" Stiffeners 6" x 3½" x ⅜" not more than 3'6" apart.
TYPE BULKHEAD
BUNKERS
C.L. of Ship
SHAFT ALLEY IN WAY OF HATCH END PILLARS
Same as Solid Floors
18" Dia.
Rev. Fr. 8" x 3½" x ½" to 9/16 Blr. Sp.
⅜ Pl. to ½ in Blr. Sp.
8 x 3½ x ⅜ to ½ in Blr. Sp.

Fig. 2.—Details of Bulkhead and Tank Construction in 7,500-Ton Hog Island Ship

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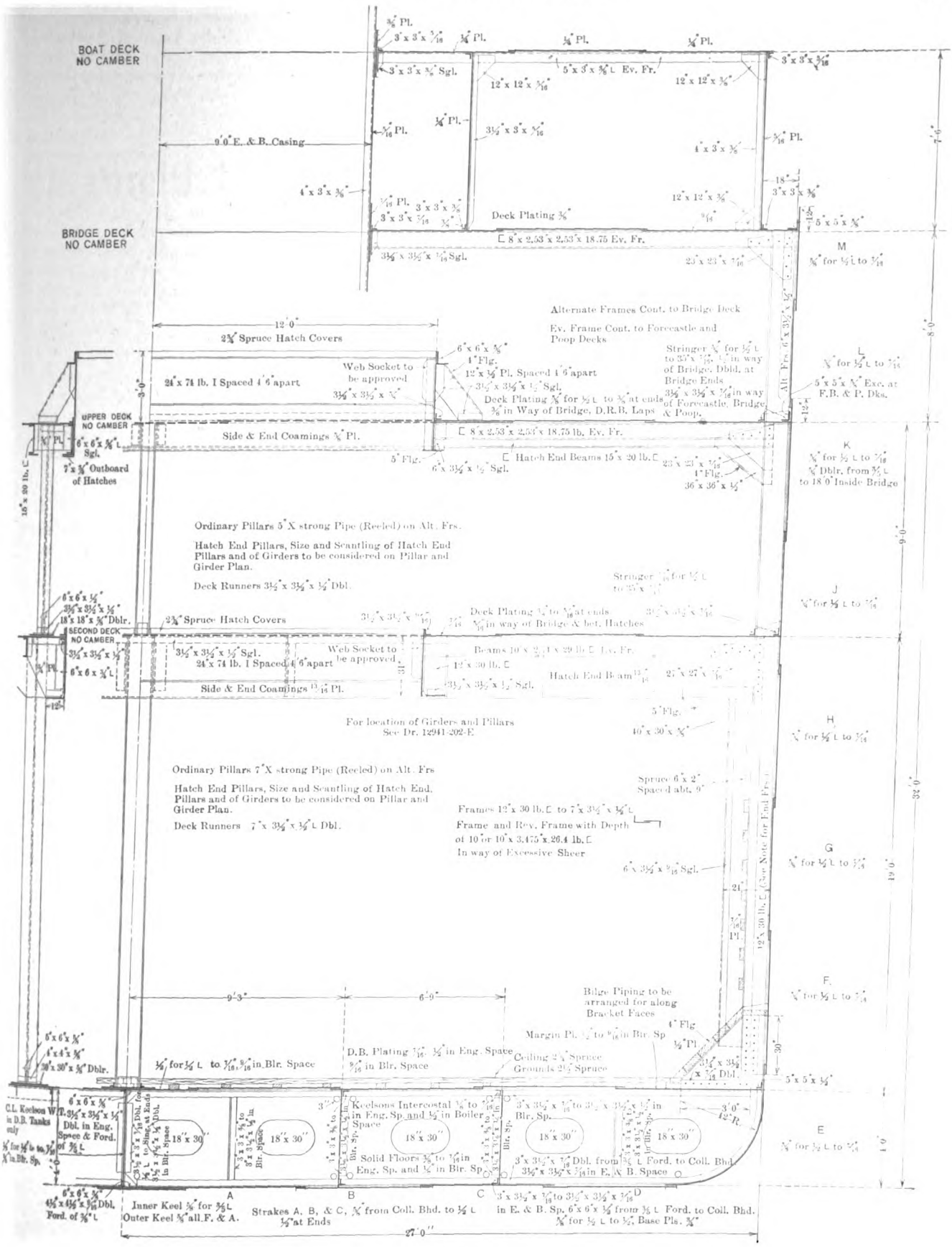
BOAT DECK NO CAMBER
BRIDGE DECK NO CAMBER
UPPER DECK NO CAMBER
SECOND DECK NO CAMBER
9'0" E. & B. Casing
Deck Plating 3/8"
8" x 2.53" x 2.53" x 18.75 Ev. Fr.
Alternate Frames Cont. to Bridge Deck
Ev. Frame Cont. to Forecastle and Poop Decks
12'0"
2¾" Spruce Hatch Covers
24" x 74 lb. I Spaced 4'6" apart
Web Socket to be approved
Side & End Coamings 5/8" Pl.
7" x 3/8" Outboard of Hatches
Hatch End Beams 15" x 20 lb.
Ordinary Pillars 5" X strong Pipe (Reeled) on Alt. Frs.
Hatch End Pillars, Size and Scantling of Hatch End Pillars and of Girders to be considered on Pillar and Girder Plan.
Deck Runners 3½" x 3½" x ½" Dbl.
Deck Plating 3/8" to 5/16" at ends
For location of Girders and Pillars See Dr. 12941-202-E
Ordinary Pillars 7" X strong Pipe (Reeled) on Alt. Frs
Deck Runners 7" x 3½" x ½" L Dbl.
Frames 12" x 30 lb. ⊏ to 7" x 3½" x ½" L
Frame and Rev. Frame with Depth of 10" or 10" x 3.475" x 26.4 lb. ⊏ In way of Excessive Sheer
Spruce 6" x 2" Spaced abt. 9"
Bilge Piping to be arranged for along Bracket Faces
D.B. Plating 7/16" to ½" in Eng. Space 9/16" in Blr. Space
Ceiling 2" Spruce Grounds 2½ Spruce
Keelsons Intercostal 5/16" to ⅜" in Eng. Sp. and ½" in Boiler Space
Solid Floors 3/8" to 7/16" in Eng. Sp. and ½" in Blr. Sp.
Inner Keel 5/8" for 3/8" L Outer Keel 5/8" all F. & A.
Strakes A, B, & C, 5/8" from Coll. Bhd. to ½" L at Ends
27'0"
A
B
C
D
M
L
K
J
H
G
F
E

Fig. 3.—Midship Section

of 29½ tons per twenty-four hours, will have a cruising radius of over 10,000 nautical miles.

At the Hog Island yard practically all of the fabrication of the hull is done in outside shops. The shipyard itself is operated merely as an assembling yard, with sufficient shops and equipment to rectify the fabricating work

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shipped into the yard which has been damaged, or for replacing parts that are needed. About 80 percent of the hull riveting is done in the yard, and only 20 percent in the fabricating shops.

The hull of the vessel is constructed on the transverse framing system and is subdivided into nine watertight compartments by eight transverse watertight bulkheads, all of which extend to the upper deck. There are four cargo holds served by five hatches in the upper and second decks and one hatch in the bridge deck.

Recent Developments in Shipyard Plants—I*

Concrete Building Slips for 1,000-Foot Vessels of 110-Foot Beam—Cranes Adapted to Special Needs—Well-Planned Structural Shops

BY NAVAL CONSTRUCTOR S. M. HENRY, U. S. N.

PRIOR to the demand for naval and merchant ships, resulting from the needs of the present war, there had been for a number of years little development in the shipyard plants. It was hard to make both ends meet, and very little money was left for expansion, either in the amount of shipbuilding equipment or in its character. In the last three years these conditions have entirely changed, and sums of money beyond the dreams of a few years ago have been provided with the view of increasing the number of ships that could be built, and of allowing the more rapid and less expensive construction of the larger vessels.

Of that class of development, which consists in providing for a greater number of vessels, we have seen the principal examples in the fabricating yards at Hog Island, Newark Bay and Bristol, though the increase in number of ways available has been by no means limited to these yards. Many ways have been added in other yards, and entirely new plants have been built up.

The second general line of development has resulted in providing bigger and more modern building slips and larger and more effective shops, in order to permit the construction of the capital ships provided in the Navy's three-year building programme, and to cut down the time of construction and save on the all-important item of labor. Development along these lines has not been required for the merchant programme, and has, therefore, taken place only at the navy yards and at the plants of the older shipyards, which have in the past been the builders of the Navy's armored vessels.

From a purely engineering point of view, that form of development is likely to be the more interesting which provides for the building of the largest vessels, the handling of the greatest weights, and, therefore, the construction of the largest building ways and shops. Where the expansion of the shipbuilding facilities has been obtained by the creation of new yards of a few ways each, it would not be expected that any unusual plant developments would result. In the case of the great fabricating yards, there are, of course, many new problems, due to the vast size of the undertakings; but on the whole it is more a question of multiplying the slips and other facilities such as exist in yards with few slips than the creation of new designs of shops or new arrangements of slips and plants. The great increase in the number of slips in the newer fabricating yards, which is required by the number of vessels to be built and the short periods of construction contemplated, involves a multiplication of the number of men formerly employed in shipyards, of the weight of material handled, of the provisions necessary for the receipt and unloading of cars, and of many of the other problems involved in the operation of the yards.

So far the expansion of the shipyards of the country has been almost entirely in the direction of shipbuilding. After the vessels now being turned out in large numbers by the Emergency Fleet Corporation have been put in service there will be a gradual shifting of the burden from the building to the repairing yards. It is perhaps well to look somewhat into the basis by which the capacities of both building and repairing yards can be considered.

Building and Repairing

As regards building, the natural unit is the building slip. A yard with so many slips should be able to turn out a definite number of vessels per year, depending on the length of time during which a vessel must remain on the ways. All other calculations are based on the number of slips provided and the estimated length of time that the vessels are to remain on the slips; that is, the extent of the shops, of the storehouses, of the fitting-out berths required, and the number of men that it is expected to employ; therefore, provisions for housing and transportation are all a function of the number of slips and the length of time on the slips.

In passing from consideration of the building problem to the repair problem, this general method of viewing the question is lost, and some other basis of estimate must be adopted. The one which seems most nearly to meet the problem is the amount of berthing space; that is, the number of vessels that can be drawn into a yard at one time on which repairs can be carried out. Assuming a definite amount of berthing space, the maximum number of ships that can be under repair at a time is determined, and the extent of shops and the number of men for which provision must be made follows more or less automatically.

Building Slips

With a basis for arriving at the facilities required per building slip, and similarly per hundred feet or per thousand feet of berthing space, means are available for arriving at a reasonable judgment as to the total requirements for yards engaged on both new construction and repair work. Some of the more important elements of the shipyards, especially those involving greatly increased size or capacity, as compared to the earlier installations, will be briefly touched on.

The building slip itself, apart from weight handling facilities, has undergone comparatively little change. Concrete has been extensively used, but the majority of the new slips are of wood pile construction, and there is nothing unusual in their size except in the comparatively limited number of slips being provided for capital ship construction. These, in general, make provision for ships of a maximum length of 1,000 feet and beam of 110 feet, being the limiting size of vessels that can pass through the

* Paper read at twenty-sixth general meeting of the Society of Naval Architects and Marine Engineers, Philadelphia, Pa., November 15, 1918.

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Panama Canal locks. So far as the beam is concerned, this does not represent a very radical increase over the largest battleships previously built, but makes provision for a very great increase in the length as compared to vessels which have been so far constructed in this country, and involves the consideration of launching weights and facilities suitable for vessels of these great lengths. In the Navy Department designs the capital slips have all been provided with an average inclination of slips of one-half inch per foot, provision being made for launching on a camber, the actual declivity of the building slips being seven-sixteenths inch per foot for the upper half and nine-sixteenths inch per foot for the lower half of the slip.

The design of these slips contemplates the use of concrete throughout, though in a number of cases, due to lack of time or money, it has been necessary to substitute wood pile construction. With concrete slips of this great length, and the height that necessarily must be reached at the upper end of the slip, provision can be made for utilizing a very considerable area underneath the slip for stowage purposes and for carrying on such classes of work as can most advantageously be done in the immediate vicinity of the vessel under construction.

Dry Dock with Reduced Draft

An interesting type of building slip, which perhaps is the first of its kind, at least on such a large scale, has been provided at one of our navy yards, where a shallow drydock has been constructed with a depth over the blocks at mean high water of 20 feet. The dock has essentially the same dimensions as the other capital slips, providing for a vessel slightly under 1,000 feet long and of a beam of 110 feet, and in the details of construction resembling other large drydocks, except that the draft is very much reduced. The caisson will be of the usual type; provision will be made for pumping out the dock, but at a very much slower rate than would be needed if it were to be normally used as a dry dock. With this arrangement the weight handling facilities could be of any type that might be selected for the normal type of slip. In this particular case the cranes are to be of the traveling, rotating, hammerhead type, with a capacity of 15 tons at 85 feet radius, electrically driven. The advantages which we look forward to in this construction are, first, of course, the elimination of the risk and expense of launching, and, second, the facilitating of the erection, due to building on an even keel, and the elimination of the difficulties incident to delivering men and materials at the height of a vessel when built on an inclination. In addition to being on an even keel, the vessel will be very much lower, approximately 50 feet, and the height of the weight-handling cranes can be correspondingly reduced. If the conditions at the yard at the time make it desirable, the vessel can be carried to any degree of completion prior to launching, with the only limitation that the draft cannot exceed the depth of water over the blocks. The other side of the picture is the increased cost, which in this particular case, owing to the subsoil conditions, not requiring piling, is not expected to be materially greater than in the case of the usual form of slip. For naval purposes, a building slip of this type has a further value, in that considerable periods of time may elapse during which building work is not carried out, and the slip will then be available for use as a drydock or a wet slip for small vessels.

There is perhaps more room for individual preference in the selection of the type of cranes to be used for handling material at the building slips than in any other feature of shipbuilding yards. This freedom of choice has been fully exercised in the extension of the older yards and the construction of the newer ones. With the exception of a limited number of special installations, such as the cableways used in some of the western yards, the available types fall into three general classes:

Crane Service for Building Slips

1. Traveling, traversing cranes. Those which have both a longitudinal travel and a cross travel.
2. Traveling, rotating cranes. Those which have a longitudinal travel and a rotating motion.
3. Fixed, rotating cranes. Those which have no longitudinal travel, and deliver their material at the desired point by rotating, and either by trolleying or luffing.

In the first class is included the cantilever type, which was in favor in the early days of large shipbuilding, but which has now generally been abandoned, at least as far as new installations are concerned; and the bridge type, which probably gives the most effective service, though generally at the highest cost. Cantilever cranes are not a desirable type on account of the great inertia of the moving part, and on account of the limited number of hooks that can be made available, the combination tending to limit the speed of erection. Bridge cranes permit the handling of the heaviest weights and provide an installation that most nearly approximates shop conditions, so far as concerns ability to deliver material at all points. The principal argument against this type is its initial cost. It has been generally adopted for the larger and more expensive slips, and some one of the rotating types has found most favor for the slips intended for smaller vessels, or where it is not feasible to finance the higher original cost.

Special Types of Cranes

The traveling, rotating types include the hammerhead and luffing types of cranes operating on wide-gage tracks on the ground, and also electric and steam locomotive cranes operating on runways of the general type used with cantilever cranes. The cost of these types are apt to be less than bridge cranes and also less than the fixed, rotating cranes, if a limited service only is to be provided. With an equivalent service as compared with the fixed, rotating cranes, the cost should not be radically different. Some very rapid construction in the last few years has been done, utilizing electric locomotive cranes on elevated runways, and where the weights to be handled are not high or the length of the ships under construction great, this gives an effective service. The cranes that travel on the ground are more expensive than is at first apparent, on account of the cost of the track installation. Their longitudinal travel is relatively slow, owing to the inertia of the moving parts. In general, this class of crane appears to the best advantage in building vessels of moderate size, where the individual weights to be handled are not large.

The fixed and rotating cranes involve a great variety of types, which include the hammerhead type, the luffing boom type, both rotating on relatively high towers, the staid type supported on the ground, and derricks placed on towers such as are in general use in building construction. In general, the most suitable field for this class of crane is the slip for smaller ships, involving the handling of small weights, as the handling of relatively heavy weights means the providing of a large capacity for most or all of the cranes. The chief objection to them lies in their relatively small capacity and short reach, necessity for large numbers of operators, and the difficulty in delivering and storing material within reach of the crane to be used in placing it on board the vessel.

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There have been some recent installations in the navy yards of the revolving, hammerhead type of cranes, which for small vessels have proved to be very satisfactory. These have a capacity of 5 tons at 95-foot radius and 10 tons at 50-foot radius, the height of hook being about 95 feet above the ground. The new capital slips being built in the navy yards are all of the bridge crane type with characteristics adopted after many tentative designs which considered capacities from 10 tons to 150 tons. The arrangement as finally adopted provides for two 40-ton cranes, each spanning the entire structure, and permitting a lift of 80 tons, with a double row of cranes above the main cranes, all of them plumbing the center line and having capacities of 10 tons each.

In these slips provision has been made for the construction of a maximum vessel of 110-foot beam, or for two merchant vessels abreast or three destroyers abreast. The clear width between the columns of the crane runways is 130 feet, and the columns slope outward so that the hooks of the cranes will plumb the centers of cars on the standard gage tracks running the length of the slip under the towers on each side. This requires a crane span of 151 feet 9½ inches. The height of the hooks of the main cranes above the yard level approximates 125 feet. The center to center width of these slips is 164 feet, and, as they provide for the construction of ships with 110-foot beam, the ratio of slip to vessel is 1.49. This is a dimension that has a direct bearing on the selection of the type of crane to be used. The ratio of the distance between centers of slip to the beam of vessel becomes in large yards a feature of considerable importance as regulating the total amount of waterfront required for a given number of ways, and to a certain extent the area of land to be included in the plant. As many factors of cost of plant bear a direct relation to the area, any unnecessary extension involves an undesirable increase in cost.

Structural Shop

The activities of the yard most directly connected with the building of ships are housed in the structural or shipfitters' shop. There has been, in the development of the larger private yards and of the principal navy yards, a tendency to adopt common characteristics, with the result that some of the largest private and government plants have adopted almost identical characteristics, though arrived at independently. In several instances the navy yards are erecting a structural group which includes not only the shipfitters' shop, but also the forge shop and boiler shop, and may later include the sheet metal and pipe shops. The shipfitters' shop in each of these cases consists of two bays, one for plate work and one for angle work, each 100 feet wide and 700 feet long, a mold loft being provided over the angle bay of the full size of that shop. The under side of the floor of the mold loft and of the roof trusses of the plate shop is at a height of 45 feet above the shop level, and the height of mold loft from floor to roof trusses is 9 feet.

The plate and angle shops are provided with three tiers of cranes, the upper tier spanning the full width of each bay, having 15 tons capacity and providing for a total lift of 30 tons; the second tier consisting of traveling jib cranes of 3 and 5 tons capacity at reaches of 30 and 20 feet with a hook height of 25 feet. The lower tier consists of special cranes intended to carry yoke riveters and smaller portable tools. For these last cranes, electric motors for travel are provided with a swinging boom and a chain hoist to facilitate the handling of such tools. The lower tier of cranes will extend for about a third of the length of the shop at the outgoing end, as they are intended primarily for work in connection with assembling and riveting.

Structural material is to be stowed on the principle followed by many of the bridge builders, a series of bridge cranes operating on runways extending across the incoming end of the shop. This stowage space will provide an area of approximately 160,000 square feet, consisting of four bays served by bridge cranes with 80-foot spans, and the area will eventually be roofed over. It is proposed to deliver material into the stowage space by standard gage tracks, and to deliver into the bays of the shop by narrow gage tracks. It is not expected that 160,000 square feet will give the full stowage area required for building and repair work for the largest yards, and further provision will be made for a reserve stowage in a less central location.

Continuous flow of work is to be obtained by the raw material entering at the end of the shop adjacent to the stowage yard, going first to the laying-off space, then to the fabricating area and thence to the assembly space and out at the opposite end of the shop, delivery from the shop to the building slips being by means of standard gage tracks. With this arrangement, a piece of material may be delivered from any point in the shop to any ship under construction with a maximum of three moves—the first from its position in the shop to a car by means of a bridge crane, the second by the transfer of the car under the slip, and, third, from the car to the location desired on the ship by a bridge crane. There is no combination of shop bays and building slips, where there is more than one of each, that can accomplish this transfer with less than three moves.

The size of plates used in ship construction has grown steadily, and an effort has been made in laying out these shops to adopt as the maximum size that we are likely to come to—a plate 36 feet long by 8 feet wide—and to provide machine tools and arrangements so that any increase in size up to this point may be taken care of without the discarding of the present outfit or its rearrangement. In comparatively recent years we have gone successively through the stages of equipping for 24-foot, 28-foot, 30-foot and 36-foot plates. The cost of equipment, especially rolls, increases rapidly at the very long lengths, and machine tool manufacturers are not generally equipped to provide machines of greater capacities, so it is likely that an increase beyond this size will not come for some time.

(To be continued.)

All Merchant Vessels Again Manned by Merchant Sailors

In consequence of the elimination of the submarine danger, with the attendant discontinuance of the convoy and other naval regulations which governed the movements of cargo vessels during the war emergency, it has been decided to man all outcoming vessels, except for the present those steamers engaged in the transport of troops, with merchant sailors. In making this decision the Shipping Board has been guided by the necessity of restoring the usual commercial conditions governing the operation of merchant vessels as rapidly as possible, in order to enable the ordinary competitive conditions to be met.

During the war it was for military reasons considered proper that many of the vessels should be under naval regulations, as they were instruments of our military operations in Europe. Many merchant vessels manned by the usual merchant crews also operated through the submarine- and mine-infested waters.

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Marine Diesel Oil Engine Problems—I*

Positive Reversing Mechanism on Two- and Four-Cycle Engines—Special Starting Methods—Auxiliary Compressor Unit for Maneuvering

BY JOHN W. ANDERSON

THE method of reversing is one of the first questions to be considered in the design of a marine engine. The original European companies adopted certain forms which they patented, and hence any new firm had to obtain a license for the use of one of the accepted types or devise an entirely new scheme. In most cases a license was obtained for the design of the engine as a whole, which, of course, included such details as the reversing gears. For instance, in this country The New London Ship and Engine Company obtained a license from the M. A. N. Company of Germany, and all of the engines built by the American company follow the German de-

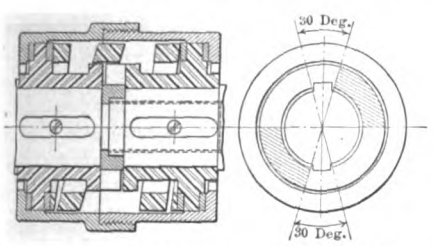

Fig. 1.—Slip Coupling for Automatic Shift or Camshaft

signs in certain particulars. This is particularly true of the method of reversing used on the two-cycle engines.

The method of reversing used on the two-cycle engines is based on the fact that in these engines the spray and scavenger valves can be set right for running in the reverse direction by shifting the cams through a common angle. One camshaft running along the tops of the working cylinders operates all the valves; there is one cam for each spray and scavenger valve, and the camshaft is shifted for reversing through an angle of 30 degrees. The camshaft is shifted automatically by a slip coupling, Fig. 1, having a 30-degree angle between the jaws, so that when the engine starts in the reverse direction the crankshaft revolves 30 degrees before the camshaft starts; that is, when the timing becomes right for the new direction of rotation. The air starting valves are operated by two separate cams, one for ahead and one for astern, and the direction of rotation of the engine is determined by bringing into action the proper cam, which in turn times the starting valve.

Method of Reversing Two-Cycle Engines

This automatic reversing mechanism fails to work satisfactorily when the engine is operated at low speed, because then the engine does not turn exactly uniformly; and since the slip clutch is of the friction type with jaws to limit the extreme travel to 30 degrees and the camshaft and its parts have inertia of their own, this slip clutch fails to hold the camshaft in exact relation to the crankshaft. This upsets the timing of the valves, which in the case of the spray valve is important.

In the 1,000-horsepower engine installed in the single-screw submarine tender *Fulton*, the shifting of the camshaft was made definite and positive by substituting, in place of the slip clutch, a sliding sleeve operated by a pneumatic cylinder under the control of the handling gear shown in Fig. 2. The vertical shaft, which drives the camshaft from the crankshaft, is cut and the sliding sleeve connects the two parts; it slides on one of them on straight keys parallel to the longitudinal axis of the shaft, and on the other on spiral grooves, so that when the sleeve is moved along the axis of the vertical shaft the camshaft is twisted relatively to the crankshaft through the same angle of shifting used in the original design, namely, 30 degrees.

To make the action still more positive, there is an automatic locking device on the pneumatic cylinder. It consists of a bar with two holes, connected to the lever operating the sleeve; corresponding to these holes there are two locking pins, one for each end of the pneumatic cylinder. The parts are so arranged that when the sleeve is in either extreme position, one of the locking pins fits into the proper hole in the locking bar and the parts are held securely in place.

When it is desired to reverse the engine, air is admitted by the handling gear to a piston on the locking pin holding the bar. This air pressure pulls the locking pin out, and when the pin is clear of the bar a port is uncovered leading to the pneumatic cylinder. The air pressure, acting on the piston in the cylinder, moves it to the other extreme position, setting the camshaft right for running in the opposite direction, and just as it reaches the extreme position it uncovers a port in the cylinder, admitting the air to the air starting valves on the working cylinders. Of course it is understood that when this gear reaches its new extreme position, the locking pin at that end of the cylinder registers with the hole in the bar and again locks the mechanism. The action is very simple and thoroughly foolproof and positive. This engine has been in service for some time now, and the reversing gear has amply lived up to expectations.

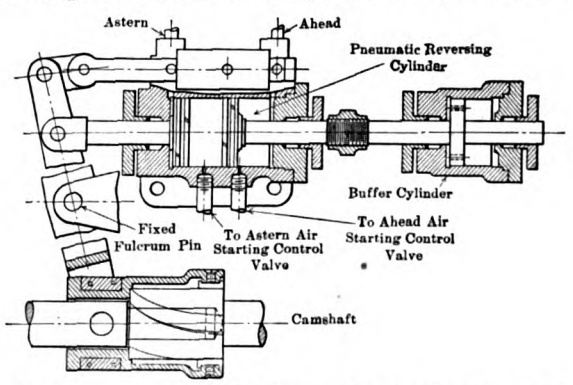

Fig. 2.—Details of Reversing Mechanism of Submarine Tender *Fulton*

Reversing Mechanism on Four-Cycle Engines

A similar method of reversing has been developed by the American company for use on four-cycle engines (Fig. 3), but unfortunately in this case it is necessary to have a separate camshaft for each kind of valve because of the different angles through which it is necessary to shift the cams in order to bring the timing right for the new direc-

*Paper presented before The American Society of Mechanical Engineers, New York, December, 1918.

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tion of running. The engines are fitted with three camshafts, one for the spray valves, one for the inlet valves, and one for the exhaust valves. The air starting valves are operated by a single cam, which is shifted by a separate mechanism to bring its timing right. The operation is pneumatic and the valves are controlled by plungers arranged radially around the single cam, in accordance with the proper sequence of cranks. All of the camshafts are shifted by means of a single pneumatic cylinder operating sliding sleeves similar to the one just described, except for the addition of a set of jaws on the camshaft, which register with jaws in the sliding sleeve in its extreme positions and take the driving effort. The work of the spiral grooves is thus confined exclusively to shifting the camshaft. As in the two-cycle engines, only a single cam is provided for each valve. This method of reversing has been applied to several engines and acts as satisfactorily in the case of the four-cycle engines as for the two-cycle.

The method of starting a Diesel engine which is almost universally used is by means of compressed air, and in

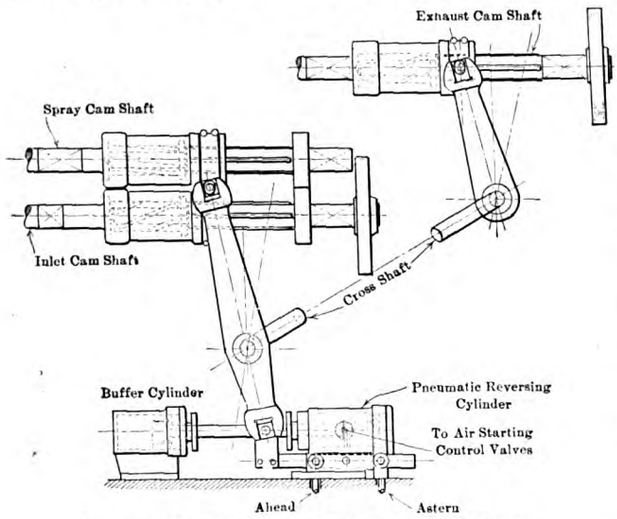

Fig. 3.—Four-Cycle Engine Reversing Mechanism

most cases the air enters the working cylinders. The objection often raised against this practice is that rapid temperature changes are produced in the cylinders by the chilling effect of the expanding starting air alternating with the heat due to compression and then, after a few strokes, the heat due to combustion. However, this method gives satisfactory service and no ill effects are known to result in the cylinder from its use.

Starting

In starting, the air is ordinarily turned on for only a few seconds, and in a few seconds more the engine can be brought right up to full power if desired. In fact, with a perfectly cold engine, the operation will be a great deal smoother under a moderate load immediately after starting than it will be at a very light load. This applies particularly at low speeds. For stationary engines which operate at full speed only, this condition is not encountered because the engine is brought up to full speed immediately after starting and the flywheel has inertia enough to keep the engine running smoothly, even though ignitions are somewhat irregular.

In a marine engine the case is entirely different. Here it may be desired to start an engine slow ahead or astern, which, with a small, light, high-speed engine, is difficult, unless a clutch between the engine and propeller permits the engine to be started up independently, warmed up, and then the clutch thrown in. The trouble in starting up when the engine is connected directly to the propeller is that in order to get the first ignition the fuel is turned well on, and when the first ignition does come there is enough energy in the combustion to overcome the inertia of the parts and drive the engine up to a much higher speed than is desired. With large, heavy engines this tendency is not nearly so marked, and it is possible to get a slow, smooth start. Here the energy of the first combustion is not nearly as great in proportion to the mass of the moving parts.

A Smooth Start on a Cold Engine

There are several ways to assist in getting a smooth start on a cold engine, and it is important to follow one of them in the case of large engines. One method is to heat the jacket water by turning steam in from an auxiliary boiler. In this way the cylinder walls can be warmed up to something approaching the working temperatures, and a smooth start is easily made. Another method, particularly useful in installations where very heavy fuels are used, is to start with a lighter fuel. By a lighter fuel is meant one that ignites readily and is more easily broken up so as to expose more surface to the heated air in the cylinder in the compression space, and thus give a quicker ignition. The solution of the problem of getting a good, smooth start consists essentially in having the temperature in the cylinders approximately the same as under working conditions and then injecting the fuel positively and regularly. Any method which does this will solve the problem.

Starting Valves on Half of the Working Cylinders

Generally speaking, stationary engines and marine engines with clutches between the engine and propeller are fitted with starting valves on only half of the working cylinders. This means that while the engine is being turned over by starting air on part of the cylinders, the others are being warmed up by the compression, and even under very adverse conditions they soon reach such a temperature that ignition is obtained. In the case of reversing engines the handling gear is sometimes modified to cause the starting air to be turned on and off the cylinders in groups. For instance, it may be necessary at times when reversing to turn the starting air on to all of the cylinders to get the engine moving in the reverse direction, and once this is accomplished the air can be cut off from the various groups in succession and the fuel turned on. The operation is performed automatically, so that it requires no attention on the part of the engineer, and the starting becomes very simple and positive. This system is also economical in the use of starting air.

Maneuvering

The question of maneuvering is principally one of obtaining sufficient starting-air capacity, either by carrying a large number of flasks or—a much better way in the case of a large ship—by having an auxiliary compressor unit of good capacity. While the ship is maneuvering, the compressor unit is kept running all the time and pumps into the starting flasks. With such a provision an engine can be reversed repeatedly with only a very small starting-flask capacity.

In the case of small powers, it is much more convenient to use a clutch between the engine and propeller and employ a non-reversing engine which is kept running all the time. The question of size of power with which this method can be used to advantage depends on the size and weight of clutch that can be obtained. The reverse

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clutches built on the Atlantic Coast in the United States are, generally speaking, rather small and light, and this is undoubtedly due to the fact that the demand is for engines of the pleasure boat type, which are of relatively high speed and of low or moderate power.

The conditions are different on the Pacific Coast, where the demand is for heavy-work boat engines with large, heavy clutches. These clutches are built up to almost any size that would be used in anything short of a sea-going ship. A clutch fitted to a four-cylinder, four-cycle engine developing 240 horsepower at 240 revolutions per minute has been in use on a tow boat for about three years now, under very severe conditions, and the tug has done some extremely good work. Perhaps the best idea can be obtained as to the duty on these clutches when it is stated that the tug is used for handling large log rafts, a work which requires continual maneuvering for hours at a time.

When a clutch is used, it is only necessary to carry starting-flask capacity enough to start the engine originally. Once it is started there is no further drain on the starting flask, no matter how much maneuvering is done, and for the smaller commercial installations, where initial cost and simplicity are prime factors, this is a very important simplification.

Operation at Slow Speed

The charge is often made against the Diesel engine that it is impossible to slow it down materially. This is true to a certain extent of the ordinary type of construction, but with the proper modifications any Diesel engine can be made to slow down and operate as readily at the lower speeds as at the higher. The solution of the problem consists in having a regular enough turning moment to keep the engine running fairly smoothly, and in obtaining definite and regular ignitions in the cylinders. The case is much simpler for a large, heavy engine which has a big mass in the moving parts, and where there are a larger number of cylinders, say at least six for a two-cycle engine and eight for a four-cycle engine, than it is for a small, light engine.

In the propulsion of a ship the power drops off very rapidly as the revolutions are reduced, and therefore at very low speeds the power is so small that when divided up among all of the cylinders in the engine there is not enough fuel injected into each cylinder to give regular ignitions. This can be remedied in a large measure by cutting out half of the cylinders. The load per cylinder will then be more than doubled and the engine will run with very light loads at low revolutions.

Control of Lift and Timing of Spray Valve

Another method consists in the control of the spray-valve lift and timing by the operator. The control mechanism is so arranged that the timing and lift are changed at the same time. In some cases the valve is made to open at the same time under all settings and to close earlier, while in others it delays the time of opening by the same amount the time of closing is shortened. Both systems appear to work satisfactorily. When it is desired to slow the engine down the fuel supply is reduced, the spray-valve lift reduced and the timing changed and the spray-air pressure reduced somewhat. The combined effect of all these is to give regular ignitions in the cylinders, hence a smooth turning moment and good control over the engine. This method is much preferable to cutting out some of the cylinders at reduced power, since it provides more impulses smaller in size and at closer intervals, which are all very vital points when running at very low speeds.

The importance of being able to reduce the spray-valve lift and change the timing when it is desired to run at low speeds over considerable periods of time will be seen at once from the following consideration: The capacity of the air compressor is determined from the requirements for full-speed running (which is the usual condition), and the amount of spray air delivered to the engine depends upon the capacity of the compressor. The amount of spray air used by the engine depends upon the product of the area through the spray valves by the time of opening. If the lift is not changed the area through the valve is constant at all speeds. If the timing is not changed the total time of opening per unit of time is the same for all speeds.

Demonstration by Numerical Example

This last statement may sound strange at first, but is best proven by a numerical example. Suppose a spray valve is open 1/10 of a revolution on a two-cycle engine and the engine makes 5 revolutions per second, then the valve is open 1/50 of a second each time, and since it opens 5 times a second it will be open 1/10 of a second per second. Now let the engine slow down to 2 revolutions per second, then the spray valve will be open $2 \times 1/20$ second, or 1/10 second per second, the same as before. That is, while the consumption of spray air is substantially the same at all speeds, yet the quantity supplied by the compressor is approximately proportional to the speed. Consequently the lowest speed at which the engine will run depends very materially upon the ability of the compressor to keep the spray pressure up. Of course a lower spray pressure is required for low than for high speeds, and in addition the compressor has some reserve capacity at full speed which is available to help out at the lower speeds, but these are effective only to a certain degree. Moreover, at low speeds, when only small amounts of fuel are injected into the cylinders, the admission of large quantities of spray air seriously interferes with ignition.

Gear for Controlling Timing and Lift

The advisability of fitting some sort of gear for controlling the timing and lift of the spray valve depends upon the type of engine and the place where it is going to be installed. Without such gear, an engine can be slowed down to about half speed without difficulty, hence for installations of small power in ships having a maximum speed of 10 knots or thereabouts it is unnecessary, because half speed means little more than steerageway. On the other hand, in the case of ships having a higher maximum speed, such as 15 or 20 knots, it is very desirable to be able to slow the engines down to quarter speed or less and then the installation of such gear becomes almost a necessity. Under some circumstances, of course, it might be considered better to sacrifice maneuvering ability for the sake of simplification, but on engines of the size used on sea-going ships the slight added complication due to this gear seems every bit worth while.

Lubrication

The question of lubrication is one that is dependent upon the type of engine. The gravity system is used successfully on large open-frame, slow-speed engines, while on the small sizes, particularly where the crankcase is enclosed, a mechanical oiler is often used with leads to separate bearings or else a system of forced lubrication.

(*To be continued.*)

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Revival of Mississippi River Traffic—I

BY M. VON PAGENHARDT*

Adequate use of the Mississippi River system for freight traffic has been made a fact by ratification of two Government appropriations aggregating nine and one-half million dollars. These appropriations, which will provide two fleets of barges and towboats to be operated as separate units on the upper and lower Mississippi River, will furnish one and one-half billion ton-mile capacity for upstream towing. The Government is now operating a temporary fleet, which furnishes two hundred and fifty ton-miles. In this paper a naval architect who has had a competent hand in the design of the equipment discusses the general aspects of this important undertaking. In the March issue, he will continue the subject by giving a detailed description of the floating equipment, which will consist of four 2,000-horsepower towboats, and twenty-four 3,000-ton all-steel, double-bottom hopper barges for the upper Mississippi fleet, and six tunnel towboats of 1,800 horsepower each, and forty 1,750-ton cargo-box barges for the lower route. Contracts for these boats have already been let and work begun upon them on the fabrication plan. In the April issue, the author will discuss the important factors involved in the most modern terminal installation, as these are exemplified in the work which has already been completed at St. Louis.—EDITOR.

WITH the passing of the war crisis, which has brought great planning minds together and developed a spirit of far-sighted co-operation among all the vast material-producing and material-carrying agencies of this country, permanent benefits are found in the wake. Most constructive and far-reaching are the plans on foot to develop and increase the possibilities of the inland waterways of the Mississippi Valley which thread the states of the central basin and work into the design of the ever-increasing network of railroads.

On July 12, 1918, the United States Railroad Administration under Wm. G. McAdoo, director general, took over the Mississippi River from St. Louis to the Gulf and appropriated eight million dollars (£1,600,000) for the construction of steel towboats and steel barges. A year ago the Emergency Fleet Corporation appropriated $3,160,000 (£632,000) for a fleet of barges and towboats to move iron ore and coal on a large scale on the upper Mississippi River as a carrier of commerce is undertaken Louis has already completed the first section of what will be a half million dollar (£100,000) river and rail terminal of the most efficient type. At last the utilization of the Mississippi River as a carrier of commerce is undertaken in an adequate, well-planned and well-supported manner.

We see before us two distinct and separate lines of development:

(a) The transportation of general freight on a trunk water line from St. Louis to seaboard in connection with the railroad systems and steamship lines.

(b) The transportation of commodity freight in bulk, such as iron ore from St. Paul to St. Louis, coal or even fuel oil from St. Louis to St. Paul, bauxite ores from the Arkansas district to the reduction plants at East St. Louis, silica sands from the La Salle district to the St. Louis foundries.

The "packet," making its individual weekly or semi-weekly trip, and the "bric-à-brac" passenger boat, even though they may now appear under the disguise of a self-propelled barge or "tunnel" boat, both belong to the times of Mark Twain. Since adequate revenue can only be derived from the basis of tonnage handled or, better, from the ton-mileage, a successful transportation scheme must be based upon quantity production of ton-mileage—either by carrying a large tonnage at slow speed or a smaller tonnage at greater speed. The possible ton-mile capacity of a towboat, however, is increased with a decrease of speed, consequently slower speeds with larger tonnage capacities are more economical than higher speeds with less tonnage.

TRANSPORTATION

The two distinct types of barge fleets planned by the Government for upper and lower Mississippi River traffic express more or less clearly this idea. The lower fleet, which was designed for the transportation of general railroad freight involving quick delivery and frequent sailings, consists of forty 1,750-ton cargo-box barges and six tunnel towboats of 1,800 horsepower each. A towing unit will consist of three barges and a towboat, or about 7,500 tons total displacement, capable of an average speed of 7 miles per hour.

The upper river fleet, on the other hand, designed for the transportation of commodity freight, consists of nineteen large steel barges of 2,500-ton capacity and four stern-wheel towboats of 1,600 to 2,000 horsepower each. Units, formed of three barges and a towboat, have about 10,000 tons displacement, capable of an average speed of 5½ miles per hour. Either towing unit has the same ton-mile production of not less than 50,000 ton-miles per hour. Assuming an efficiency of operation of 50 percent and a season of 240 days, the ton-mile production of either unit per season is 150 million ton-miles, which would provide a capacity of 100,000 tons

> The river cities and towns should immediately provide suitable wharves equipped with the most modern machinery for loading and unloading cargoes, together with adequate switch and other railroad connections. Elevators and warehouses should also be provided and ought to be begun without a minute's delay. Coincident with the work outlined, the business interests should organize and arrange to furnish cargoes to the capacities of the boats. This is the only way to get a fleet in the first instance, the only way to increase it, and the only way to keep it. The child is born. Don't let it die for want of a little attention during its infancy.
>
> JAMES A. REED, U. S. Senator, Missouri.

* Naval architect, St. Louis, Mo.

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Fig. 1.—The First Barge Unit Leaving St. Louis for New Orleans

carried a distance of 750 miles each way. With a minimum value of only 1 mill per ton-mile, either towing unit would, therefore, show a yearly earning capacity of $150,000 (£30,000).

Practical considerations have influenced the selection of floating equipment to as great an extent as any underlying rules of economy. As is often the case with railroad transportation, given certain service conditions, it will probably seem preferable in some cases to use smaller barge units at greater speed with more frequent sailings than larger units with less frequent trips.

The Government service established on the Mississippi by order of the Railroad Administration is founded on the knowledge that regularity and dependability of service are the most satisfactory basis for permanent growth of trade traffic. A. W. Mackie, manager of the Mississippi River section and for five years active manager of the Missouri River merchandise barge line, carried the idea into effect by offering weekly sailings both from St. Louis and New Orleans. Twenty-nine all-steel merchandise barges and five towboats were placed at his disposal to establish the service.

"There are three things which will make the Government river service a success," Mr. Mackie has said. "First, the higher freight rate assures us of a greater income, even maintaining our differential of 20 percent. For instance, the rate on wheat, which forms the greatest bulk of our downstream freight, is raised from 1.57 mills per ton-mile last year to 2.26 mills per ton-mile this year; the rate on sugar, which forms a large part of our upstream tonnage, is raised from 2.36 mills per ton-mile last year to 5.85 mills per ton-mile this year. Present freight capacity with our temporary equipment may be only 250 million ton-miles per year, but with the prospective ton-mile revenue of, say, 2.5 mills, you can judge for yourself whether or not we will be self-sustaining. Second, the fact that we have contracted for six powerful towboats and forty barges of steel construction and modern design assures the stability of the service and justifies the shipper in rearranging his traffic to include this line. Third, the establishment of through freight rates in connection with railroads and steamship lines assures a dependable tonnage and enables us to serve a very large territory."

General Freight

The success of such a general freight line depends on the proper co-operation of many factors, in themselves indifferent or even opposed to the rivers service,—the general public, the shippers, the railroads, the steamship lines. To make a success of the new project under such conditions requires a complete knowledge, by those in control of policies of development, of operating conditions, and sufficient Government authority to secure co-operation of all factors involved. Further, there is the need of proper terminals with efficient handling machinery, without which a general freight service could not be made a success. The results to be obtained from the successful establishment of a trunk water line will, however, more than jus-

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tify efforts and financial expeditures, and the forms of development will point out clearer and clearer the underlying rules, *i.e.:*

1. Towing units of maximum ton-mileage capacity should be utilized, even with a sacrifice of speed.
2. The river fleet should be designed for towing upstream instead of down, as at present.
3. A gradual gravitation toward heavy bulk freight should be fostered for export and import, in conjunction with the higher revenue domestic package freight.
4. Establishment of freight terminals should be made with Government aid, so that the conditions governing one city or terminal could not jeopardize the profits of the other cities interested.

Commodity Freight

The uilization of the Mississippi River for commodity freight is *a priori* successful, if undertaken on a sufficiently large scale. Well-planned routing and manipulation of freight to provide return tonnage are also involved in economic operation. Thus the transportation of iron ore from St. Paul to St. Louis—from the iron ore mines of Minnesota to the furnaces and the wealth of smelting coal of St. Louis, a distance of 675 miles on the Mississippi River—with a guaranteed return tonnage of coal, justifies expenditure in river equipment in line with the tonnage requirements.

The credit for laying this plan before the Government authorities must be given to E. F. Goltra, who, backed by detailed reports of the chief of engineers covering the technical execution of the transportation problem, succeeded in obtaining the Shipping Board's appropriation of $3,360,000 (£632,000) for the construction of the required fleet. Designs were made under the direction of the chief of engineers by Wm. S. Mitchell, engineer in charge of the St. Louis district and a member of the Government Experimental Towboat Board, and were drawn by J. W. Gerell, naval architect of the Mississippi River commission.

The result is a fleet of nineteen 2,500-ton barges and four stern-wheel towboats of 1,600 to 2,000 horsepower, which, based on the experience of the engineer office, embodies the necessary features of commodity freight transportation in the boldest form. With the assured "balanced" tonnage, "maximum" loads and terminal facilities at each end of the line, the barges were made 300 feet long, 48 feet wide and 10 feet deep. Thus the towing unit is reduced from the customary five- to eight-barge tow to a three-barge tow—the ideal form. The towboat is designed to push or pull the barges. Four units are planned to operate simultaneously for a period of 240 days. The greatest available draft may be reckoned as 8 feet during the high-water period. The minimum draft for the barges might be estimated as 4 feet; for the towboat even 3 feet probably would be sufficient. The four units are expected to transport 200,000 to 270,000 tons of ore downstream, and the same amount of coal up-stream per season.

Thus, by the expenditure of about four million dollars (£800,000), a commodity fleet is procured to move half a million tons of ore and coal per season a distance of 675 miles. To move this tonnage by rail between St. Louis and St. Paul, 1,200 cars and 16 locomotives, or an expenditure of about ten million dollars (£2,000,000) would be required, and this expenditure does not include expenditure in right-of-way, tracks and yards. In other words, this floating equipment will release 1,200 cars and 16 locomotives for higher class railroad commodities, while the lower class freight is carried by water.

As a transportation problem of national importance, this new programme has vital significance. Commodity freight, coal and iron ore, being a heavy burden on the railroad system, is ideal tonnage for water carriers. Again, while a railroad track is strictly limited in the amount of traffic it can handle, the carrying capacity of the Mississippi River is unlimited as to the amount of tonnage that can be towed in either direction. The waterway represents the nation's natural transportation safety factor; its tonnage capacity can be expanded at will by the addition of floating equipment. It represents the nation's peaceful preparedness for any heavy demand on traffic, inasmuch as any amount of commodity freight can be diverted to the waterways.

The inherent difficulties of general freight transportation—solicitation of freight, through tariffs, terminal expense—are not present when only commodity freight is handled, and the assured, balanced, maximum load possible on the upper Mississippi permits a reduction of the ton-mile cost, only paralleled by the greatest inland waterway—the Great Lakes.

The complete possibilities of the Mississippi River transportation system for general freight will only be realized when terminals at all points are efficiently equipped and when the managing organization, after extensive solicitation of freight, is able to utilize the full capacity of the equipment. Regulations controlling free tariffs and other strictly legislative features will, of course, further the development.

(*To be continued.*)

Preservative Coatings for Iron and Steel

FOR preserving iron and steel, it is the primary coat which is of the utmost importance, the succeeding coats being less so, while the final coat may consist of any good oil paint tinted as may be desired. When the three coats are to be applied, it is recommended that the second coat should consist of equal parts of the priming coat and of the finishing coat, the difference in color between it and the priming coat then being sufficient to show when every part of the surface has been covered. Red lead has been used for a number of years as the pigment for the priming coat. It belongs to the class of pigments known as inhibitors. Attention, however, is drawn to a series of tests on steel plates conducted by the American Society for Testing Materials, the results of which are quoted here:

Average Rating of Paint Tests

No.	Pigment	1910	1911	1912	1913	1914
9	Orange mineral.....	9.0	8.3	6.9	4.0	3.0
10	Red lead.....	8.7	8.3	8.1	6.3	4.0
16	Natural graphite.....	9.1	6.8	6.6	6.2	4.0
17	Artificial graphite.....	7.1	5.9	5.9	2.6	0.0
34	American vermilion....	9.1	10.0	10.0	9.8	7.5
36	Medium chrome Yellow	7.0	7.7	7.7	5.2	3.5
39	Zinc chromate.....	9.4	9.5	9.5	8.0	4.0
41	Chrome green.....	9.8	9.8	9.8	7.6	5.0
	Chromate	9.5	9.7	9.7	8.3	4.0

The figures represent the condition of the coated plates after exposure as compared with the original condition, which is rated at 10. It will be observed from these tests that the pigments showing the greatest inhibiting powers are the chromates, and especially the basic chromate of lead known as American vermilion. The high cost of this pigment has so far militated against its more general use, but it has better covering properties than red lead and, moreover, it has only about half the weight of the latter pigment, so that it yields a larger volume of paint. It is also much less prone to settle out in the can than is red lead.

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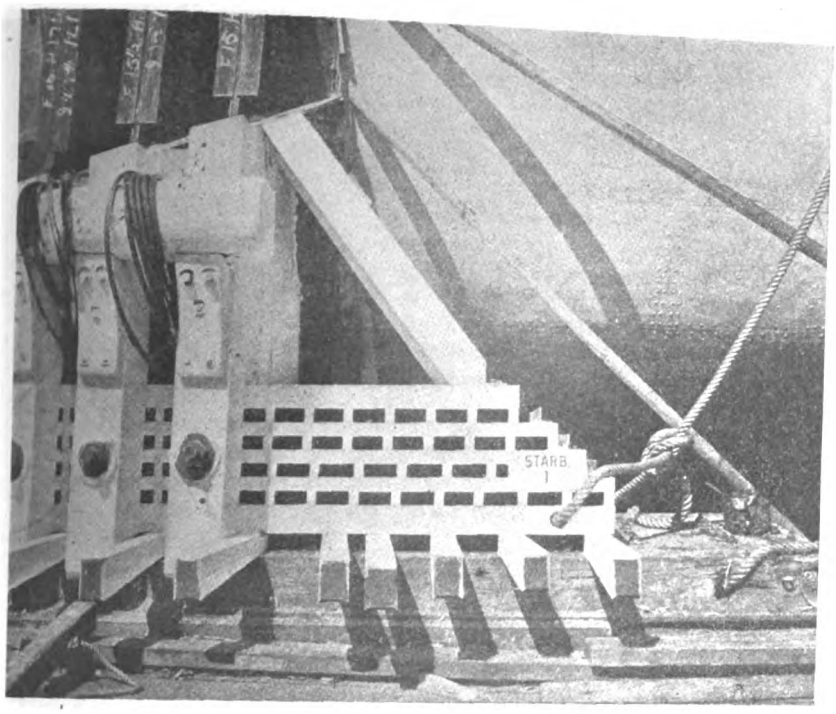

Fig. 1.—Showing Fore Poppet of Vessel with Crushing Strips in Place

NOTES ON LAUNCHING*

Use of Crushing Strips in Fore Poppets as an Effective Method of Distributing Pivot Pressure—Calculations to Determine Number, Size and Spacing

BY WILLIAM GATEWOOD†

IN connection with the launching of large and heavy vessels, for which launching calculations are made, two conditions of the operation usually receive especial attention:

The pivoting pressure, or reaction on the ways when the stern begins to lift.

The minimum moment against tipping.

The calculations as usually made are well known to naval architects, and may be found described in the transaction of this and kindred societies, and in text-books on naval architecture. The calculations assume that the level of the surface of the water is not disturbed by the entrance of the vessel, that the vessel itself remains rigid, and that the alinement of the groundways is not disturbed by the passage of the vessel. The pressures and moments obtained by the calculations must necessarily be approximations only, since the assumed conditions cannot exist in the actual launching. It is probable, however, that the results are relatively comparable, and that the calculations can be relied on with confidence in making the essential preparations for the launching.

Pivoting Pressure

Suitable provision for taking the pivoting pressure on the fore poppets was early recognized as essential, because the concentration of pressure received visual confirmation at almost every launching. It was recognized, also, that some means of distributing this pressure is necessary, as theoretically the pressure is concentrated on the extreme forward end of the sliding way. In the early days, the fore poppets were built of timbers on end; but it was soon noticed that this was not a good practice, as the compression of end grain wood is quite small compared with the compression when the grain is flat. By building up the fore poppets with the wood laid flat, an appreciable amount of compression occurs at the forward end when the vessel pivots, and the under surface of the sliding way is enabled to remain in contact with the upper surface of the groundway over an appreciable length, thus distributing the pressure between the two pairs of surfaces.

As the launching weight of vessels increased and the pivoting pressures changed from a few hundred tons to more than two thousand tons, some more definite means of distributing this pressure became necessary. The introduction in the fore poppets of a considerable depth of soft wood with grain flat seems to have served the purpose in some cases, notably in the launching of the *Lusitania* and *Mauretania*. A special rotating device or rocker formed as a segment of a trunnion has been used successfully, as described in volume 22 of the Transactions of this Society. Curving or cambering the forward end of the fore poppet cribbing to introduce a clearance for the adjustment of the bearing surfaces has been used, as noted in the discussion on the paper above referred to. Strips of soft wood especially proportioned to crush under pressure were used in the fore poppets of certain vessels launched on the Pacific Coast, as described in volume 12 of the Transactions of this Society.

The use of crushing strips in the fore poppets seems the most simple and the most effective method of distributing the pivoting pressure, and the calculations to determine the number, size and spacing of the crushing strips are not very elaborate. It is desirable, of course, to select for the crushing strips material which is uniform in quality; and white pine, flat grain yellow pine, or Port Orford cedar would seem suitable, as fairly uniform material can be obtained and the compression curves show the proper characteristics. In Fig. 2 are shown average compression curves for flat grain yellow pine and Port Orford cedar. These curves indicate that crushing begins at about 650 pounds per square inch for yellow pine and at about 750 pounds for Port Orford cedar, for which pressures the compression is less than 4 percent, and that for a compression or crushing of 30 percent the pressures are about 950 pounds per square inch and 1,200 pounds per square inch respectively. These curves are based on samples of

*Paper read before twenty-sixth general meeting of the Society of Naval Architects and Marine Engineers, Philadelphia, Pa., November 15, 1918.

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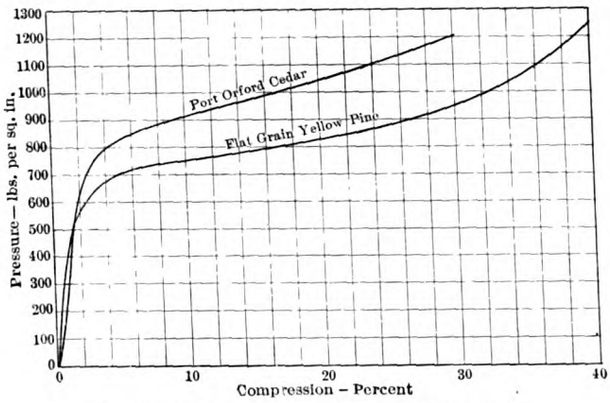

Fig. 2.—Average Compression of Crushing Strips

width equal to or greater than their height, and the variation of pressure from the mean at 30 percent compression was less than 10 percent for a large number of samples, when care was taken to eliminate resiny and unseasoned yellow pine. Slightly different values were obtained when the width was less than the height.

In order to determine the most suitable arrangement of crushing strips, it is necessary to calculate the reactions and the change in grade of the keel or sliding ways for several positions after pivoting. In Fig. 6 the reactions for a certain vessel are plotted in tons, and the angle between the sliding way and the groundway in inches per foot of length on base of distance slid and of length of overlap of ways. The curve of minimum mean pressure per foot run is obtained by dividing the reaction by the length of overlap of the ways, and it is evident that such pressures can only be obtained if the whole of the overlap of the ways is in bearing. They are based on a static launch, and are modified materially when the overlap is approaching zero by the launching velocity of the vessel as compared with the pitching period of the vessel.

The height and general construction of the fore poppet will determine what depth of crushing strips can be fitted, and the maximum crushing in inches which can be counted on will regulate the portion of the overlap of the ways which will be in contact. If we call the reaction R, and the angle between the ways expressed in inches per foot of length as a, and the maximum crushing at the forward end of the fore poppet as C, then the length of overlap in bearing will be $C \div a$, and the mean pressure per foot run on this bearing will be $\frac{R \cdot a}{C}$. The value of this mean pressure is plotted in Fig. 6 for two values of C — 3.6 inches and 4.5 inches, corresponding to 30 percent compression on 12 inches and 15 inches depth of crushing strips respectively. A convenient method of determining the distribution of the crushing strips would be to take the maximum pressure as thus determined and lay it off at the after end of the overlap in bearing corresponding to the position of the vessel where this maximum occurs (17.3 feet aft of forward end of fore poppet for $C = 4.5$ inches from data on Fig. 6), and consider it as the pressure at which crushing should just start. At the forward end of the fore poppets lay off a pressure at which crushing should just start if, when the crushing corresponds to the value of C, the pressure is the same as the pressure laid off at the after end of the length in contact. This will be about 70 percent of the mean pressure if flat grain yellow pine is used and 30 percent compression is allowed in determining the value of C. When these two spots are joined by a straight line, we have the distribution of pressure at which crushing should just start to give a uniform pressure over the length of bearing when account is taken of the crushing.

Determination of Pressure on Crushing Strips Aft

It will be found that the pressures at which crushing should start for points aft of this region may be laid off to advantage the same as the highest point just determined. and for a distance aft such that the area of the pressure diagram is equal to the pivoting pressure. The diagram will show the distribution of pressures at pivoting, as a greater pressure at any point would crush the strips, and this cannot occur before there has been a change of angle due to pivoting.

The curve of maximum pressure per foot run can be obtained by laying out the distribution of pressure for intermediate positions of the vessel up to the jump off the ways, although, as previously mentioned, the excessive pressures on the tip of the fore poppets would be experienced under static conditions only. Such a curve is indicated in Fig. 3. This curve shows a certain amount of crushing at points where later there is no crushing or less crushing, and the elasticity of the wood will probably enable the crushing strips to partially accommodate themselves to this condition, provided the percentage of crushing is not too great.

Use of Crushing Strips Satisfactory

The pressures obtained by this method would probably be reduced somewhat by the bodily lowering of the vessel due to the crushing, unless the pivoting point assumed in the calculations corresponds to the point of no crushing.

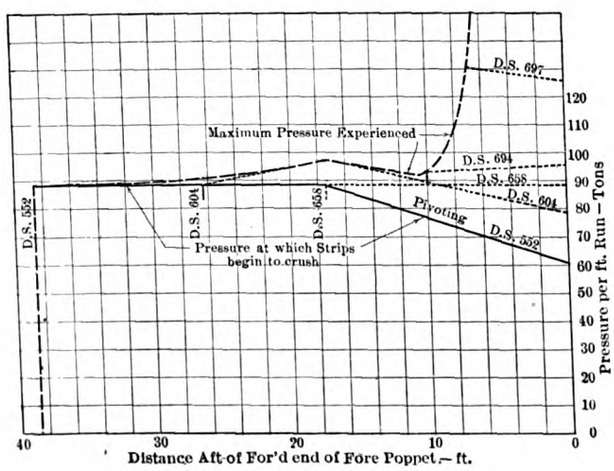

Fig. 3.—Pressures in Fore Poppet

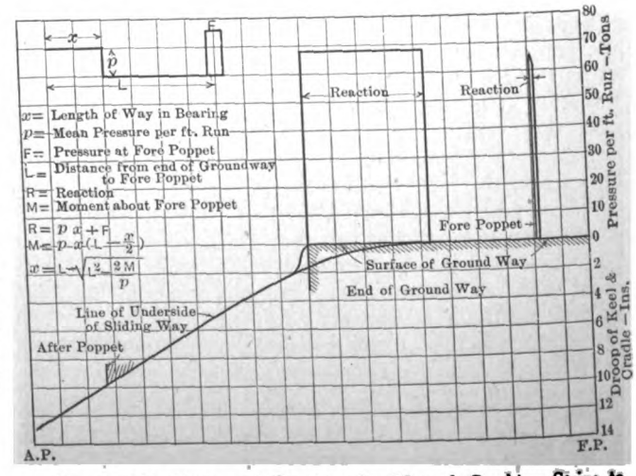
x = Length of Way in Bearing
p = Mean Pressure per ft. Run
F = Pressure at Fore Poppet
L = Distance from end of Groundway to Fore Poppet
R = Reaction
M = Moment about Fore Poppet
Reaction
Reaction
Fore Poppet
Surface of Ground Way
End of Ground Way
Line of Underside of Sliding Way
After Poppet
A.P.
F.P.
Pressure per ft. Run — Tons
Drop of Keel & Cradle — Ins.

Fig. 4.—Distribution of Reaction by Use of Crushing Strips to Overcome Deflection of Vessel

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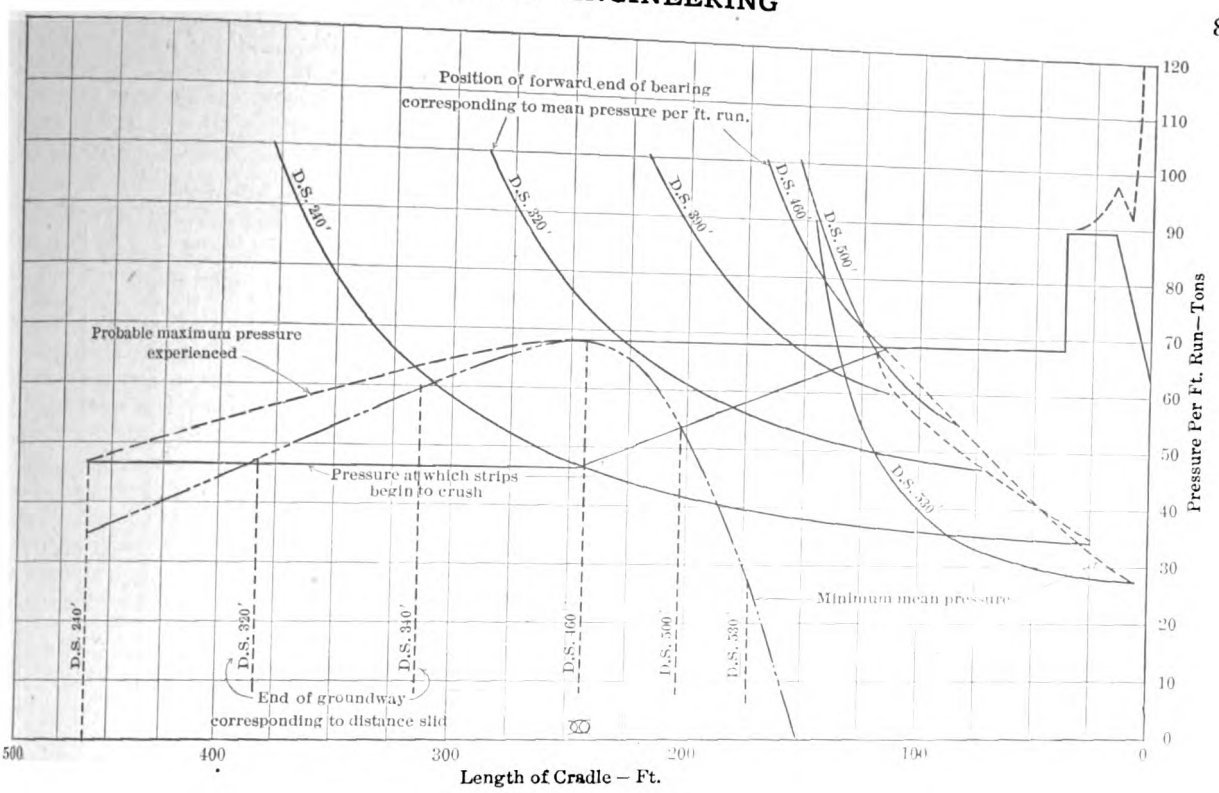

Fig. 5.—Pressures in Cradle

Fig. 1 is from a photograph of the fore poppets of a vessel with crushing strips arranged somewhat as described in the preceding example. The crushing strips seemed to serve their purpose admirably, distributing the reaction over the strap supports and distributing the pressures over the standing ways so that no trouble at all was experienced from the high pivoting pressures. The same arrangement was repeated for a sister vessel with similar success, the material of the crushing strips being white pine, which has about the same crushing curve as yellow pine. It will be noticed that the crushing strips are in four layers, which gives stability to the structure; and there is a further crushing of the division boards where the crushing strips bear, which adds to the adaptability of the design to distribute the pressures.

Further refinements may be made in the calculations, if desired, to obtain full advantage of this method of distributing the pressures. On the other hand, the crushing strips are able to stand almost any amount of overloading without disintegrating, and their use cannot fail to help distribute the pressures, even if fitted without reference to any calculations at all.

Way End Pressure

The minimum moment against tipping is primarily the measure of safety against the lifting of the fore poppets from the ways and the bodily tipping of the vessel backwards as the center of gravity of the vessel passes the end of the groundways. Many of the smaller vessels have "tipped" in launching because it was considered too expensive to extend the ways a suitable distance under water. Usually, no damage has resulted from this practice, as the pressures have been comparatively small, and the ways were so supported as to "give" appreciably during the tipping.

On larger vessels, however, even with a considerable moment against tipping, damage to the floors under the flat of the bottom has resulted, caused by the concentration of pressure over the outboard end of the groundways as the part of the vessel which was damaged passed over that spot. This concentration of pressure is not indicated directly by the calculations as usually made. Special calculations are often made, however, in an endeavor to determine these pressures. In these calculations, it is assumed that the vessel and ways do not change shape and that the distribution of reaction on the ways can be represented by the ordinates of a trapezoid, having a length equal to the overlap of the ways, an area equal to the total reaction corresponding to the particular overlap selected, and with the center of gravity of the trapezoid at the center of gravity of the reaction. If the center of gravity is nearer the end of the groundways than one-third of the overlap, the trapezoid becomes a triangle whose base is three times the distance of the center of

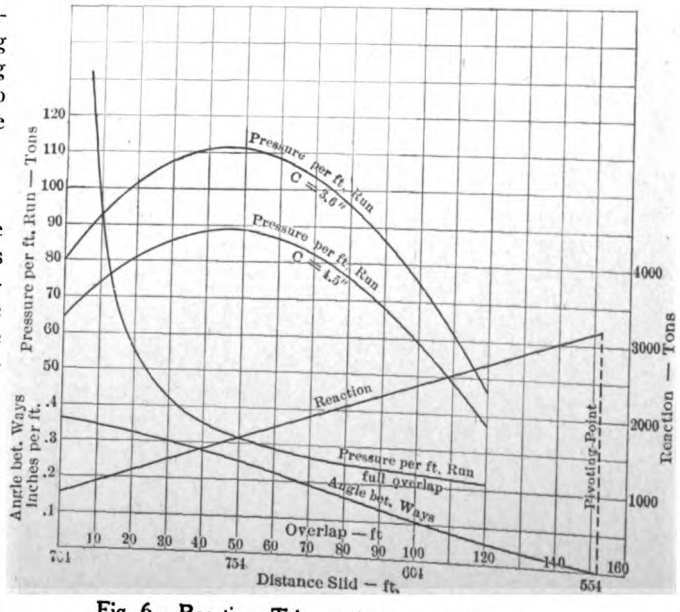

Fig. 6.—Reaction, Trim, and Pressures After Pivoting

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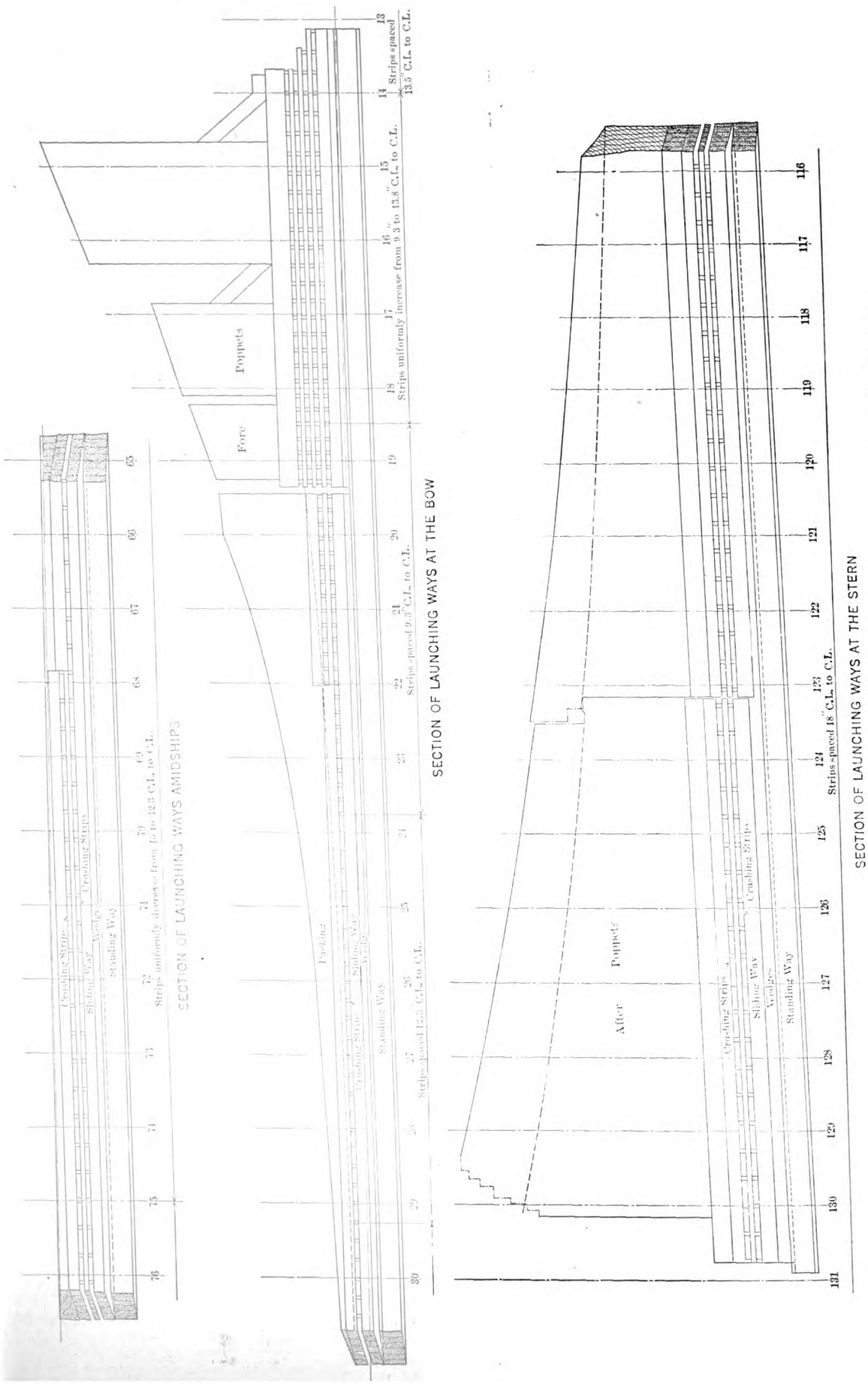
SECTION OF LAUNCHING WAYS AMIDSHIPS
SECTION OF LAUNCHING WAYS AT THE BOW
SECTION OF LAUNCHING WAYS AT THE STERN
Poppets
Fore
After
Parking
Sliding Way
Standing Way
Crushing Strips
Wedges
Strips uniformly increase from 9.3 to 13.8 C.L. to C.L.
Strips spaced 13.5" C.L. to C.L.
Strips spaced 9.3" C.L. to C.L.
Strips spaced 12.6" C.L. to C.L.
Strips uniformly decrease from 12.6 to 12.3 C.L. to C.L.
Strips spaced 18" C.L. to C.L.

Fig. 7.—Sections of Launching Ways at the Stern, Amidships and at the Bow Showing Arrangement of Crushing Strips

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gravity from the end of the groundways, and there is assumed to be no pressure at all at the forward end of the fore poppets. This method of determining the pressures under the bottom of a vessel was used in preparing for the launch of the *Lusitania,* was described in volume 12 and was illustrated in volume 22 of the Transactions of this Society.

Method of Determining Pressures Based on Theoretical Assumption

The method of determining pressures under the bottom, above described, is based on an assumption which can hardly be realized in practice. The condition which controls would seem to be that the vessel does not remain straight, but yields to the bending forces which come into play during the launching. The natural impression which one gets of a large vessel afloat is that there is no longitudinal bending. Both theory and actual measurements, however, show that vessels are flexible beams, and records of measurements are given in our Transactions. In the process of launching, the bending moments are quite pronounced and can be approximated with some degree of certainty, although considerably more data must be accumulated before they can be calculated with accuracy. Measurements taken during launching show the effect of these bending moments on the upper deck, as the stringers show considerable stretching during the passage of the vessel down the ways.

The effect of this bending of the vessel is to tend to concentrate the reaction of the ways prior to pivoting at two points—the outboard end of the groundways and the forward end of the fore poppets. The relative intensity of these two forces would vary to suit the center of reaction, and the sum of the two forces would be the total reaction on the ways, or land-borne weight. The reaction at the outboard end of the groundways would be a maximum before the position of minimum moment against tipping is reached, and is equal to

$$\frac{Wa - By}{l},$$

in which Wa is the moment of the weight about the forward end of the fore poppet; By is the moment of buoyancy about the forward end of the fore poppet; l is the overlap of the ways.

The settling of the ways, compression of the packing, and deformation of the bottom of the vessel all tend to distribute this way-end pressure, but it is manifestly unlikely, if not impossible, that the distribution of pressure can be as indicated by the trapezoidal formula. The use of crushing strips in the packing under the bottom has suggested itself as a means of distributing this bottom pressure, just as it has served as a satisfactory means of distributing the pivoting pressure. The calculations to determine the amount of the crushing strips required are not so simple as in the case of the fore poppet strips, but the following method would seem applicable.

Obtaining Distribution of Reaction on Ways

From the launching calculations, determine for several positions of the vessel the reaction on the ways and the moment of this reaction about a point chosen, say 10 feet aft of the forward end of the fore poppets. Determine, as indicated in Fig. 4, the length from the after end of the cradle over which a certain mean pressure per foot must be applied to afford a reaction which will have the same moment as above described. Obtain similar lengths for other mean pressures, and plot the series of curves through the points so obtained (see Fig. 5). Note the points on these curves at which the reaction at the fore poppet becomes zero, as this gives the minimum mean pressure which is practicable. The highest point of the curve joining these points of minimum mean pressure gives the maximum mean pressure which need be experienced if the crushing strips are suitably arranged.

If the strips are arranged so that they will just begin to crush at the forward end of the bearing thus determined, and if they are arranged at the after end of the bearing, over the end of groundways corresponding to this position of the vessel, so that they will give this pressure per foot run after having been crushed sufficiently to permit of this length of bearing, the mean pressure per foot run over the whole length of bearing may be obtained by arranging the strips in between so that they will begin crushing at the proper pressure to give this mean pressure after crushing to suit the curvature of the vessel in this position. It is assumed in the diagram in Fig. 5 that a straight line variation will prove satisfactory.

If we assume that the wedging up has adjusted the cradle so that no bending will occur to localize the pressures until after the after end of cradle has passed the end of groundways, it will be seen that in the after poppets the pressure will be not much different from the mean pressure due to the weight of the vessel. In that part of the cradle, therefore, the crushing strips can be arranged to give only a slight margin over this mean pressure, say about 25 percent, to allow for irregularities in the strips.

The crushing strips can be arranged to give uniformly varying pressures between the after end of cradle and the outboard end of the bearing for maximum mean pressures (shown uniform in the diagram) without causing the above determined maximum mean pressure to be exceeded. Between the inboard end of this bearing and the outboard end of the fore poppet bearing, an arrangement of strips to give uniform beginning of crushing would seem satisfactory.

Obtaining Maximum Pressure Over the Way-End

In order to determine with accuracy the maximum pressures over the way-end when crushing strips are fitted as above outlined, it will be necessary to calculate the deflection of the vessel in several positions and plot the pressures corresponding to the crushing and spacing of the strips, as indicated in Fig. 5, to give the proper reaction and moment. The curve shown in Fig. 5 represents the probable maximum pressures which will be experienced if the crushing strips are sufficiently thick to actually cause the sliding way to accommodate itself to the groundway.

In Fig. 7 is shown the distribution of crushing strips which corresponds to the pressures shown in Fig. 5. Four rows of 2-inch by 3-inch strips are shown in the fore poppet, one row is shown where the height is limited, and two rows amidships and aft, where there is sufficient height to fit them.

One further condition needs to be mentioned. Although the crushing strips do not exert nearly as much pressure in returning to their original thickness as they do in being crushed, the recovery is appreciable, and there will be a considerable pressure exerted between the bottom of the vessel and the sliding way outboard of the end of the groundway. This pressure may be sufficient to break the sliding way if there is an appreciable crushing of the strips, as the sliding way has considerable rigidity. The excessive bending moment on the sliding way may be relieved by cambering the last few feet of the groundway.

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Analysis of Freight Movements at Terminals

Outbound and Inbound Quay and Pier Transference—Movements in Warehouse and on Vessel—Standardized Machinery Available

BY H. MCL. HARDING*

TO be able to adapt and to apply standard machinery to the transferring and handling of miscellaneous freight at marine terminals, it is essential not only to know and fully understand the movements of the freight under the usual commercial traffic conditions, but also the reasons why freight is moved in this manner. Without this knowledge, it is difficult to comprehend how machinery can be correctly adapted to the proposed work, so as to attain the desired speed and economy for successful competition in foreign trade.

As a general proposition, it may be said that adequate facilities should provide for a continuous succession of rapid, mechanical movements without congestion and without manual rehandling. Mechanical apparatus should serve every square foot of area horizontally and every cubic foot of space vertically.

Terms Used in the Analysis

It is preferable to consider separately, first, the freight movements on the quay; second, the movements on the pier, and finally a combination of movements on both pier and quay. By thus separating the movements, the operating methods are more clearly set forth and defined. In the following analysis "transference" signifies freight movements from one place to another, as between vessel and shore; by "handling" is meant the assorting, distributing and tiering of freight chiefly on the shore and within the shed. "Stowing" refers to the placing of freight within the vessel. The first series of movements described pertain to the inboard freight of the quay.

* Member, advisory board, Port and Harbor Facilities Commission, United States Shipping Board.

Quay Inbound Transference

This comprises the following freight movements: From vessels (ships, or barges and lighters with or without masts) to the shore and to other vessels; from the vessel to the railway car or dray, stationed near and along the quay wall; from the vessel to the open quay areas or to the quay transit shed. Secondary movements provide for further transport from the transit shed to railway cars or drays, located in front or to the rear of the shed; from the transit shed to the terminal warehouse; from the warehouse to railway car or dray for inland destination.

Quay Outbound Transference

This transference consists of the movements from the terminal warehouse to the transit shed; from the transit shed to the vessel; from railway cars or drays to the warehouse; from railway cars or drays to the transit shed; from cars or drays to open quay areas; from cars or drays directly to vessels; from inbound vessel to outbound vessel, as between ships, barges and lighters.

Quay Inbound Handling

This refers to longitudinal and transverse traverse within the shed or on the open quay areas, including

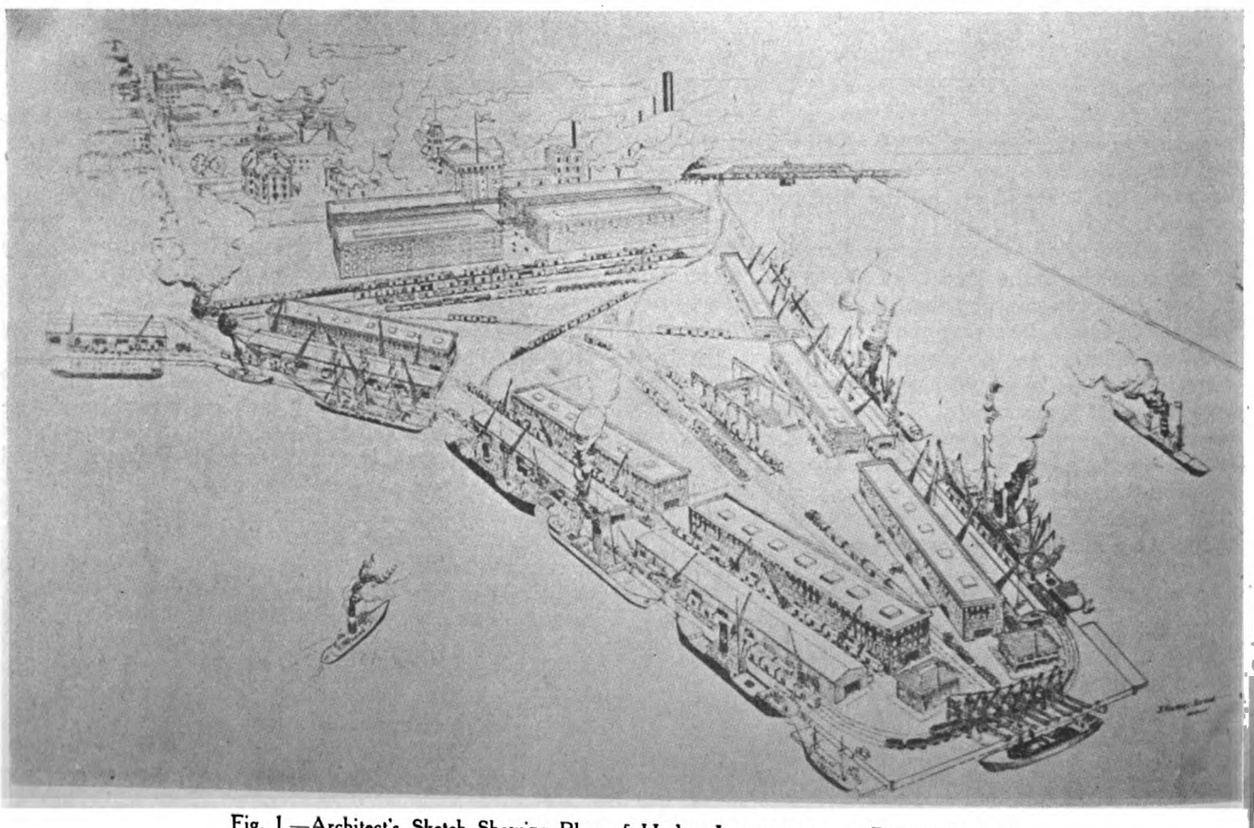

Fig. 1.—Architect's Sketch Showing Plan of Harbor Improvements at Beaumont, Texas

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freight movements in many directions for the assorting, distributing and tiering, all according to the marks or cross marks, for still further transport (after this handling) by railway car or by dray or by transshipment.

QUAY OUTBOUND HANDLING

There is much less handling of outbound freight than of inbound. In many instances the freight can be transferred directly from railway, car or dray to vessels without handling. Provision, however, must be made for longitudinal and transverse traverse with the assorting, distributing and tiering on the quay within or without the shed.

The four operations described above represent the principal freight movements in connection with the quay. The following analysis pertains to the additional freight movements on piers which are provided with side and end berths.

PIER INBOUND TRANSFERENCE

These freight movements are from vessels berthed at the two sides of the pier or at the end of the pier to cars on the pier; from vessels to open pier areas; from vessels to pier transit sheds; from vessels to open quay areas; from vessels to railway cars or drays on the quay; from vessels to other vessels berthed on the opposite side or end of the pier or alongside; from vessels to terminal warehouses on the quay; from the pier shed by secondary movements to cars and drays on the pier; from the pier shed to the open quay areas; from the pier shed to cars on the quay; from the pier shed to the terminal warehouse on the quay.

PIER INBOUND HANDLING

These are the longitudinal and transverse movements for assorting, distributing and tiering on the open areas or within the pier shed.

PIER OUTBOUND TRANSFERENCE

These are the movements from the warehouse on the quay to open pier areas; from warehouse to pier transit shed; from warehouse to vessels berthed on the sides and end of the pier; from cars on the piers to the pier shed; from pier shed to vessels; from vessel to vessel, as from ship to ship, or from barge and lighter to ship alongside or across the pier.

PIER OUTBOUND HANDLING

Where the freight is to be held temporarily for shipment, it may have to be assorted, distributed and tiered. This is accomplished by longitudinal and transverse movements often in the pier shed or on the open pier. The shipment, on the other hand, is often made up in the warehouse instead of in the shed. In some cases there is little outbound handling, but provision must be made to prevent congestion.

WAREHOUSE MOVEMENTS

In addition to the above, there are various freight movements *within* the warehouse. These movements include the transferring of freight between the different floors of the warehouse and the handling of it on the various floors.

Since the warehouse is intended for long storage, often for many months, the simplification of the mechanical movements involved in the handling are not nearly so important as in the transit shed, where freight must be moved within twenty-four to seventy-two hours. Movements between warehouse and vessel must, of course, be performed with great rapidity.

FREIGHT MOVEMENTS ON THE VESSELS

In addition to all the freight movements already described, are those of the inbound freight on the vessel after the "breaking down" of the stowed cargo. These operations include the movement between decks and through and above the hatches of the ship, including the burtoning. The burtoning of the outbound freight is also to be considered, as well as the lowering within hatchways, the movements between decks and the final careful stowing.

It would seem as though the number of movements as enumerated is already extensive, although the weighing, customs-inspection, and the disposition of held over or held up freight, of damaged or dangerous shipments and of goods held for customs rebate have not been mentioned. Such movements must also receive thorough consideration.

The above analysis is intended to cover freight movements of every kind, nature and description and of such dimensions and weights as are usually limited by the ship's tackle and will pass within the doors of the standard freight cars. All of the above movements can be performed by mechanical means. In addition, provision must be made for freight of greater sizes and weights. Such freight, however, can be lifted, transferred and handled at a much slower speed.

CHARACTER OF FREIGHT

The usual miscellaneous freight generally will be the same as transported on the railways—packages, bales, boxes and barrels, long pipes, rails, lumber, girders and more or less bulk freight. It should be remembered that the machinery installed for this work is for a public terminal, which is intended to give service to manufacturers and dealers in *every* commodity and for *every* class of merchandise. For terminals devoted exclusively to the handling of one special commodity, the installation of special machinery is a requisite.

STANDARDIZED SERVICE MACHINERY DESIRABLE

It is of importance that at public terminals, or those which transfer and handle all classes of freight, there should be few types of machinery, and that these be of a universal character. Complete co-ordination of the different freight movements is essential. No movement should be considered as operating independently of the others; all are more or less connected. By their perfect articulation, speed, economy and great terminal capacity are possible. Commercial success in foreign trade depends upon the installation of adequate harbor facilities.

Equipment of Los Angeles Harbor

In making a claim before the Shipping Board for allocation of vessels to local navigation companies of Los Angeles, Cal., the port facilities for handling cargoes were enumerated in detail. These include a floating steam crane of 90-foot beam of 20 tons capacity; a locomotive crane with 36- and 49-foot beam of 15 tons capacity; a floating "A" frame with shear legs of 80 and 100 tons capacity; two electric wharf trucks, three gasoline (petrol) tugboats, ten lighters of from 400 to 1,000 tons capacity, one "A" frame barge and one fully equipped fireboat. One 3,000-ton dry dock is now available. Another 10,000-ton floating dock is now constructed.

The report also shows that 500 acres of anchorage are available—200 acres in the outer harbor with 48 feet of water, and 300 acres in the inner harbor with 30 feet of water. The total length of dockage on the waterfront is 33,460 feet.

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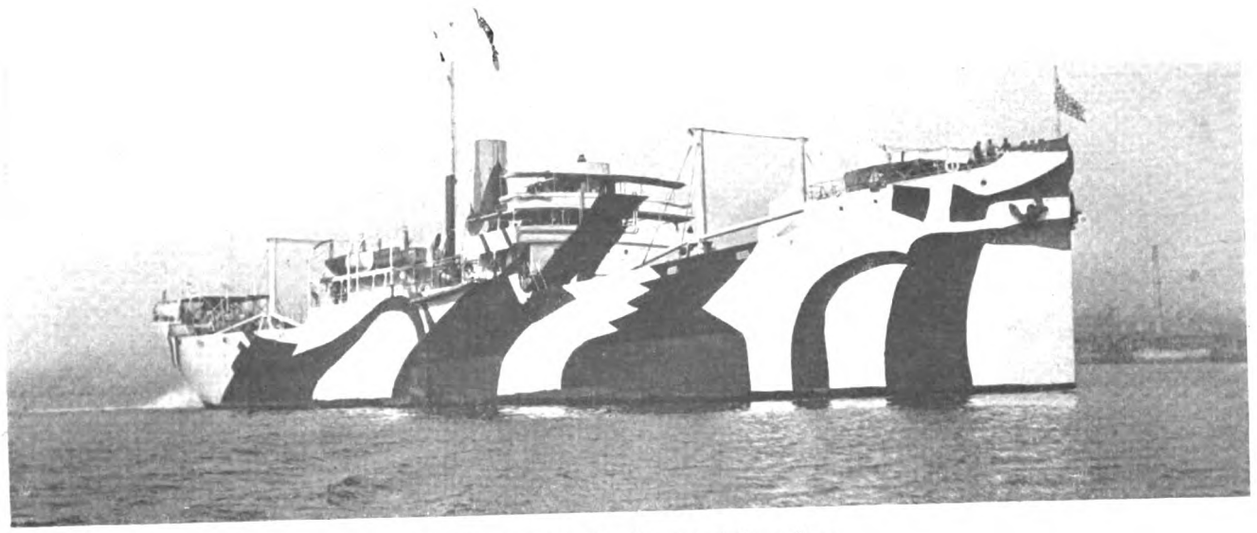

Fig. 1.—American Development of Camouflage

Principles Underlying Ship Camouflage

Complementary Colors Produce Low Visibility—Dazzle System of Ambiguous Perspective Disguises Ship's Course—Special Color Effects

BY ALON BEMENT*

PRIOR to January, 1918, there were five systems of disguising ships recognized by the Ship Protection Committee of the United States Shipping Board; and, therefore, granted concessions in insurance rates. They were the culmination of that effort at concealment which, before the war, found its expression in the painting of the battleships gray. These systems were all of the low visibility type; and, though in some cases color and in others black and white were used, it was all for the same purpose—to produce gray at a distance.

Mixing Complementary Colors to Produce Gray

William Mackay was first in the field. He had been interested in concealing coloration before the war broke out, and with Commander Fisher had made experiments on small government vessels before there seemed any likelihood of the United State being involved. His theory was based on the fact that complementary colors, when mixed in the proper *proportions,* will produce gray. The truth of this contention can easily be demonstrated by the use of colored cards on a rapidly revolving wheel. If given areas are painted in the same proportions of color as those that produce gray on the wheel, and are carried far enough from the observer, the colors will seem to mix, and the areas, therefore, will become gray in the same manner as they do on the wheel. It was claimed that the gray thus produced was, owing to its greater atmospheric quality, much superior in its powers of invisibility to that of the ordinary gray paint.

The other systems, with the exception of Warner's, while varying somewhat in method, all embodied the same principle. Warner, who came late into the field, combined with a two-color low visibility effect some of the elements of the dazzle, which, at that time, began to appear on British ships.

Appended is a list of the systems, with some of the main characteristics of each, in the order in which they were accepted by the Ship Protection Committee:

The Mackay System—Three colors in spots

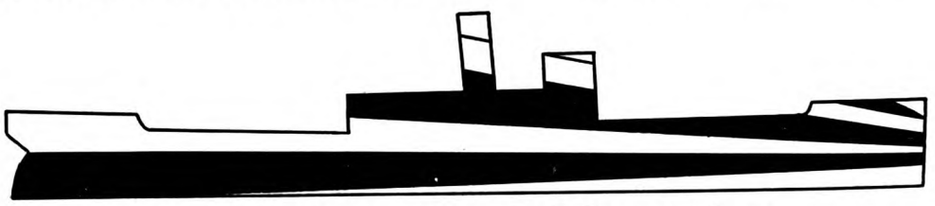

Fig. 2.—Use of Perspective Lines to Disguise Distance and Course

The Herzog System—Colored line resembling grain of wood

The Brush System—Black and white only

The Tock system—Color and wave line

The Warner System—Two colors and element of dazzle

Now these low-visibility schemes were effective to a certain degree, but they all had the same important defect. Their low visibility depended on atmospheric conditions. Given a gray day with a slight mist, they were very effective; but should the sun shine in any direction

* Camoufleur, United States Shipping Board.

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except from behind the observer, they were ineffective. The catastrophes of the spring of 1917 proved that the camouflage of the low-visibility type was failing in its aim. Von Tirpitz was making good his boast to sweep clean the seas, when Commander Norman E. Wilkinson, then a junior officer in the British destroyer fleet, evolved a camouflage immeasurably superior to the old systems. His idea was not to render the ship invisible, or even hard to see, but to prevent the submarine from determining its course, speed and character.

This camouflage was based on the fact that the submarine must, under ordinary conditions, submerge for a long period between her last observation and the attack. If, then, the submarine commander could be misled in his calculation of the ship's course, he might rise to find himself too far away to deliver a blow; or, as has happened many times in the last eleven months of the war, find himself coming to the surface in the path of the ship, broadside on, and comparatively helpless.

Fig. 4.—Offsetting Rake of Stacks

Dazzle System Distorts Normal Perspective

It is said that the momentary confusion of a hawser hanging over the bow of the destroyer with the stem gave the commander his first idea of this new camouflage. Whether this is true or not, the dazzle was begun by painting several broad stripes up and down on the bow, with the intent that they should be mistaken for the stem. The British submarine men made a favorable report almost immediately, and it soon became apparent that by wrapping a band at an angle across and around the stem, or converging several of them toward a point on either side, the whole bow could be made to seem out of line. This converging of lines involved known rules of perspective. If the bow could be thrown off by perspective, why not any part of the ship? Experiment proved that by a proper use of perspective lines any part of it could be made to seem far away, in just the same way that distance is acquired in a street scene on paper by converging lines running toward a vanishing point. This is exemplified in Fig. 2. With the drawing held at arm's length, the bow of the ship will seem farther away from the observer than the stern.

Fig. 5.—Solid Lines Conceal Bridge

Now, although this design does its work well from a broadside view, there are two reasons why it could not be applied to a ship in just this simple manner. In the first place, the enemy would understand the deception and guess very nearly the amount of deviation from the ship's course; also, while this design protects the ship from off the beam, it does not offer any protection from astern or ahead. Consequently it would have to be supplemented by other designs to cover the whole area of the ship viewed from every point, as indicated in Fig. 3. A design of this character may be said to have three attributes: It would make the vessel seem to be off her course from ahead, abeam and astern; the masses of white near the water line at the bow would reduce the visibility of the bow wave, and make it hard to calculate her speed; and, under favorable atmospheric conditions, the markings would seem to shorten her length by losing certain parts of the bow and stern against the sky.

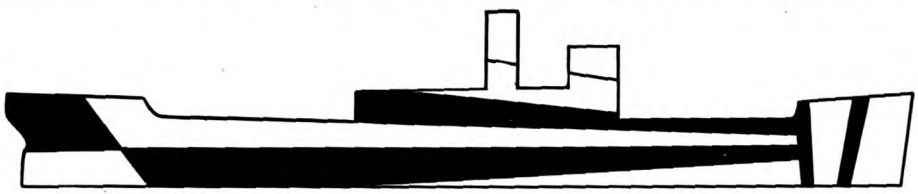

Fig. 3.—Further Use of Perspective Lines Which Disguise Course from Every Angle

View of Stacks and Masts Distorted

At this point the British under-seamen reported that, while this designing was effective as far as it went, they had no difficulty in getting the course of the ship from the masts and the bearing of the stacks over the bridge. Experiment proved that the masts could be fairly well confused by painting them different colors, one light and one dark; offsetting them a few feet was found to be a still better method. In the new ships, the design called for only one mast, which was set alongside the stack amidships. The stacks were painted with the design running against the slant to overcome their rake aft, and the tops cut with white or some light color to shorten them, as shown in Fig. 4. During the summer of 1918 several British ships appeared with the stacks built up to the vertical with a wing-plate forward at the top and another at the back below. It was an expensive method, but it served to show the faith the owners put in this particular kind of camouflage.

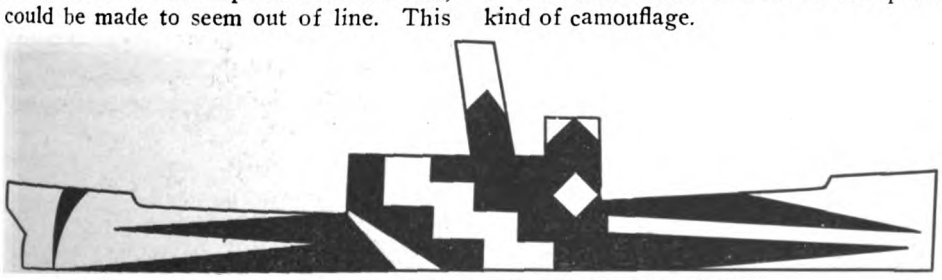

Fig. 6.—Ambiguous Dazzle Amidships Conceals Direction of Course

Disguising the Bridge and Superstructures

The last and the most difficult problem that presented itself to the camoufleurs was the breaking up of the bridge and super-structure. Characteristic as they are in shape, and towering as they do sometimes 70 or 80 feet above

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the water line, with vertical corners that catch the sunlight on one side and throw deep shadows on the other, they were very difficult to disguise. It is here that the greatest failures were made, but in the effort to confuse these angles the most interesting additions were made to the knowledge of deceptive perspective. In the attempt to make the vertical plane of the front of the bridge seem to swing out and connect with the side of the hull, which is at right angles to it, many interesting discoveries were made. It was found that by extending several parallel stripes of color from the waterline diagonally aft to the rail, and then extending a similar set on a diagonal up the forward end of the house to the bridge, that the two sets would seem to connect and continue to do so while the ship swung through several degrees. Thus it became exceedingly difficult to tell whether the observer was seeing the front of the bridge or the side, as the whole area covered by the striped design would seem a single solid wall (Fig 5).

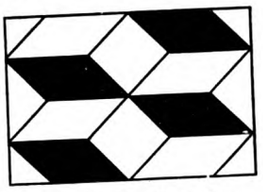

Fig. 7.—Showing Ambiguous Perspective

The same effect was obtained by extending a very wide band of color from midships up and forward, the lower edge reaching forward along the rail for 20 or 30 feet, and the bulk of the band turning the corner of the house and extending on up to the bridge. The sharp splinter of color along the rail connected with the color on the front of the superstructure. The effect was the same as in the first case, since the color arrangement made it difficult to decide just what relation the two vertical planes had to each other. Consequently, as the observer was not able to recognize the space occupied by the front of the house, he could not tell how the ship was heading.

At this point Commander Wilkinson stumbled on a practical use of the hitherto almost abandoned theory of ambiguous perspective—that kind of perspective which can be read both ways, and appears now and then as a puzzle in a picture book (Figs. 7 and 8). By a slight effort of the will the observer can see the stairs right side up or the reverse, the dark surfaces as indented or raised. This kind of perspective is valuable to the camoufleur, not only because it assists in breaking up the masses of the superstructure, but because, superimposed over the ordinary perspective, it conceals its motive. While the enemy could very easily have understood and recalculated upon the perspective of Fig. 3, the introduction of ambiguous perspective at intervals upon it would make it almost impossible for even an expert to decipher. By the application of a good ambiguous design to the midships section of a ship, with perspective lines converging away from it forward and aft, it could be made to seem to turn both ways (Fig. 6). Towards the end of the war the American designs had a very decided tendency in this direction, while the English made a sharp return to the many small and parallel stripes they had used at the very beginning. The American method was effective at a distance of from four to ten miles; the English design produced confusion at a very close range (Fig. 9).

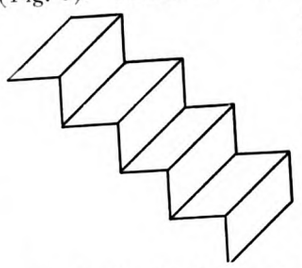

Fig. 8.—Showing Ambiguous Perspective

Purpose of the Colors Used

The choice of colors to be used was a simple one. Black and white offered the strongest contrast obtainable. A line between the two gave the sharpest edge—one that could be seen farthest. A corner casting a shadow presents a very strong edge; the only line that can offset it is one between black and white. The camoufleurs usually tried to turn or wrap the corner with a diagonal line, black above and white below. If this did not completely obliterate the corner it reduced its effect perceptibly. The strong blue was used because it presents the least contrast

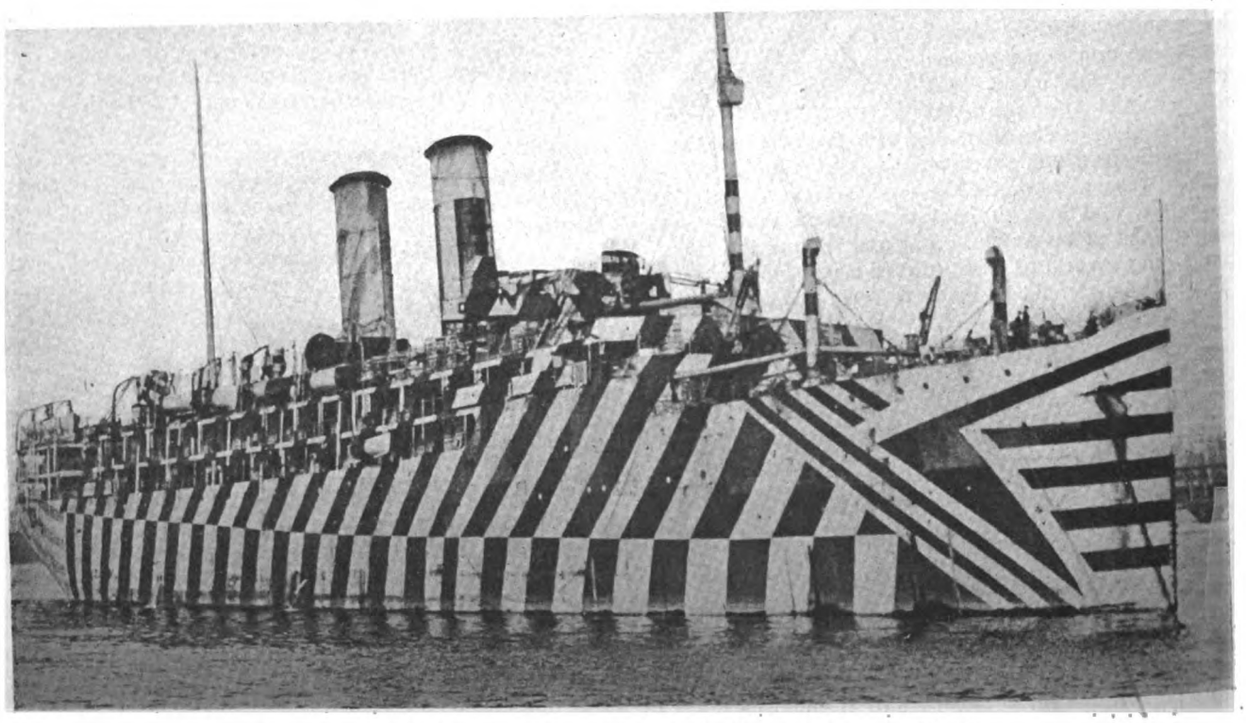

Fig. 9.—The English System of Camouflage as Applied to a Passenger Vessel

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between its light and dark side. A round object painted with it will seem less round than it would if painted any other color; blue has the quality of being strong in the shadow and dull in the light. A quaint old French writer on color, Vebert, noticed this fact, and observed that it might have been occasioned by excess of modesty. The other colors were used for contrast, but in choosing them care was taken to select colors that the Germans could not screen out. Vermilion, the strongest red, can be nullified and made to seem almost white by the simple expedient of placing a color screen directly over the periscope dial.

This, the so-called English dazzle system, was adopted by the United States Navy and the Shipping Board early in 1918, and went into effect immediately. After March 1, the Shipping Board ruled that no ship could clear without it, for by that time it was recognized that the most fatal error the U-boat could make was to miscalculate a ship's course. Beyond question it was the frequency with which they committed this very error that mitigated against a successful underseas campaign.

Twin-Screw Steam Towboat—The Peace

Constructed for Inland Waterway Service—Extreme Shoal Draft Type—Propulsion by Compound Condensing Engines

IN view of the interest which is being taken in tow boats for use on inland waterways and shallow rivers, the accompanying photograph shows a very successful steel steamer of this type. This vessel, which was designed by J. Murray Watts, N. A., of Philadelphia, has just been completed by the Dravo Contracting Company, of Pittsburgh, and is now in use on the Monongahela and Ohio Rivers.

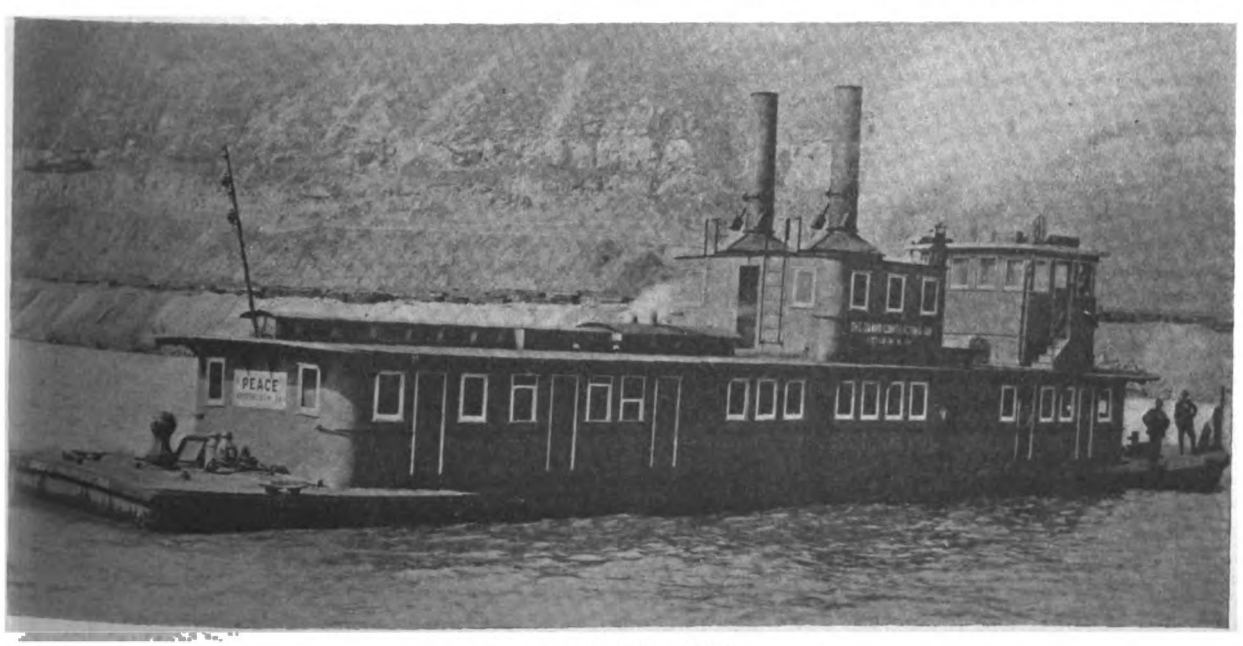
The general dimensions are: Length, 112 feet; beam, 22 feet; draft, 3 feet. The boat is propelled by compound engines of 250 horsepower each, built by the Hyde Windlass Company. Each engine drives a propeller 4 feet 4 inches in diameter. These propellers, housed in a pair of tunnels, are so arranged that the lower edge of the blades is above the bottom line of the vessel, in order that these will not be damaged should she go aground.

Steam is supplied by two large vertical boilers, 5 feet 7 inches in diameter and 15 feet long. The large size of these boilers allows a full head of steam to be carried without any difficulty; it also gives a good reserve of steam for operating the steam syphons and for pumping out the bilges of the barges which the boat may be towing.

The hull is constructed of mild steel throughout, reinforced with steel trusses to withstand the hogging strains on such a shallow hull. A steel deck house and wooden pilot house have been provided. The coal and water supply is carried in the hull. Excellent accommodations for the crew are provided in the deck house, in the after end of which are staterooms for the captain and for the eight members of the crew. A spare stateroom, bathroom and toilet room are also included. To insure ventilation in the hot summer months, a continuous skylight is built over these quarters, ventilating each stateroom. Forward there is a large galley, a pantry, a store room and a good-size dining saloon. The pilot house is raised about 3 feet above the deck house, and this space is utilized for a large gravity tank for culinary purposes.

Fitting of Five Rudders Aids in Maneuvering

Owing to the shallow draft, five rudders are fitted—three aft and two in the tunnels, forward of the propeller wheels. A Dake steam steering gear and a Dake double-steam capstan are fitted, also a hand-operated capstan on the after deck. A 5-kilowatt electric plant, operated by a De Laval turbine, furnishes current for the cabin lighting and the searchlight. In waters where the sternwheel type of steamer with simple non-condensing steam engines has been the rule, this compound condensing, propeller-driven tow boat has given a good account of herself, showing decided superiority in lightness, speed and economy.



Towboat *Peace* for River Work

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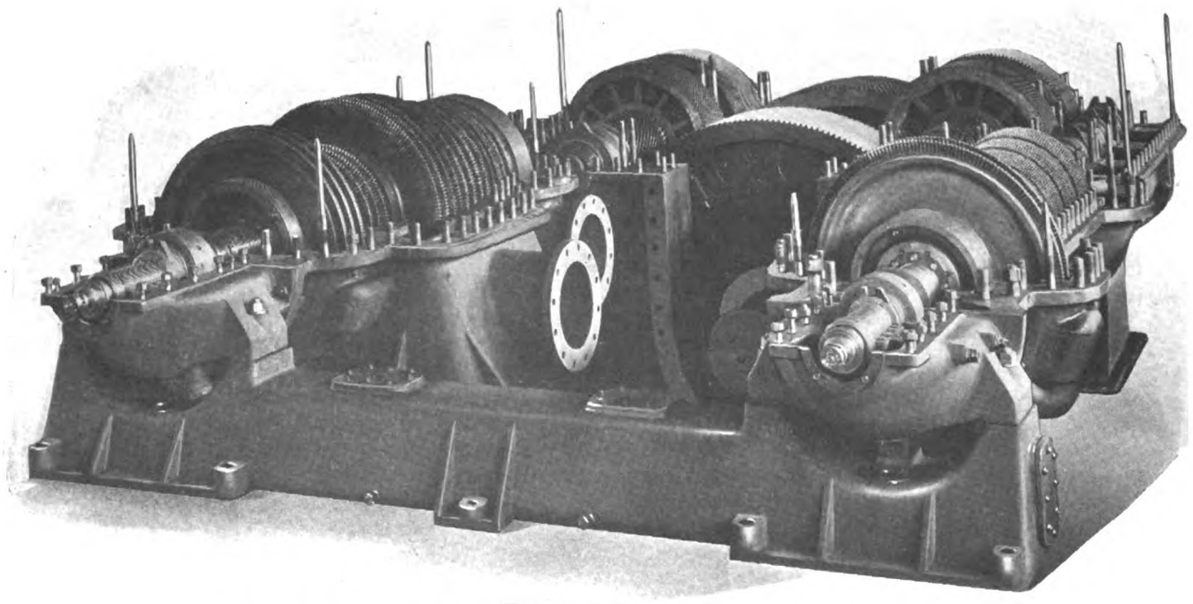

Fig. 1.—Main Engines of the *Marino Odero*, with Gear and Turbine Casings Removed

Italian Geared Turbine Cargo Steamer

Built by N. Odero & Company, at Sestri Ponenti, and Fitted with Tosi Geared Turbine Propelling and Auxiliary Machinery

THE first cargo vessel built in Italy to be equipped with Tosi geared turbine propelling machinery is the *Marino Odero,* which touched the port of New York during December on her way to Savannah. She was destined for an early return to Italian ports with a cargo of cotton. This vessel, which was completed during 1918 by the N. Odero & Company, at Sestri Ponenti, under Lloyd's supervision, is 378 feet long, 51 feet beam and 30.2 feet depth. The gross tonnage is 5,495, and the net tonnage 3,369. The general arrangement of the vessel is shown in the accompanying plans.

The Propelling Machinery

The machinery of this vessel is of special interest, since the complete equipment was supplied by the firm of Franco Tosi Company of Legnano and Milan, Italy.

The propelling machinery consists of a Tosi geared turbine unit, designed to develop a shaft horsepower of 2,100 to 3,000, with the propeller shaft turning at a speed of from 65 to 80 revolutions per minute. The unit consists of one high-pressure and one low-pressure turbine, with an astern turbine incorporated in the low-pressure casing. The reduction gear is of the rigid type, already described in the April (1918) issue of Marine Engineering.

Turbine-Driven Auxiliaries

The turbine-driven auxiliaries, consisting of the circulating pump and two boiler feed pumps, both of the centrifugal type, are also of Tosi design. The condenser is fitted with two steam ejectors of the Leblanc type to extract the air in the condensing chamber. The capacity of one boiler feed pump is 20 tons per hour, at a pressure of 265 pounds per square inch. Only one of these pumps is used in ordinary service, the other being used as a reserve; this pump is driven by a 20-horsepower steam turbine, running at 5,000 revolutions. The water circulating pump is actuated by a 50 to 60 horsepower turbine, running at 5,500 revolutions per minute. The latter drives through a reduction gear.

Pump for the Extraction of Condensed Steam

A centrifugal circulating water pump and a lubricating oil circulating pump, running at 500 revolutions per minute, are combined with a vertical centrifugal pump for the extraction of condensed steam. This pump is driven by means of a helical gear from the pump shaft.

The turbine-driven auxiliaries are reported to have operated with complete satisfaction during the 12,000 miles which the vessel has already traversed, partly in convoy and partly in free navigation. An inspection after the long run failed to show signs of corrosion in the turbines or wear on the gear wheels.

Boilers

The electric generators and blowers are driven by engines of the reciprocating type. Steam is supplied at a working pressure of 190 pounds per square inch by two three-furnace Scotch boilers. The fuel consumption is given as 33 tons per twenty-four hours, when the vessel is traveling at her normal speed of 9 to 9½ knots and the boilers are operating under the conditions for which they were designed.

In addition to the turbines mentioned above, the Franco Tosi Company are builders of steam engines, boilers, crude oil and Diesel engines and other marine equipment. They have built turbines direct-connected with the propeller shaft up to 25,000 shaft horsepower, which have been installed upon fast scout boats, destroyers and other craft of the Italian navy.

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THE first cargo with Tosi gea the *Marino Odero,* during December on tined for an early r cotton. This vesse by the N. Odero & Lloyd's supervision, feet depth. The gr nage 3,369. The g shown in the accom

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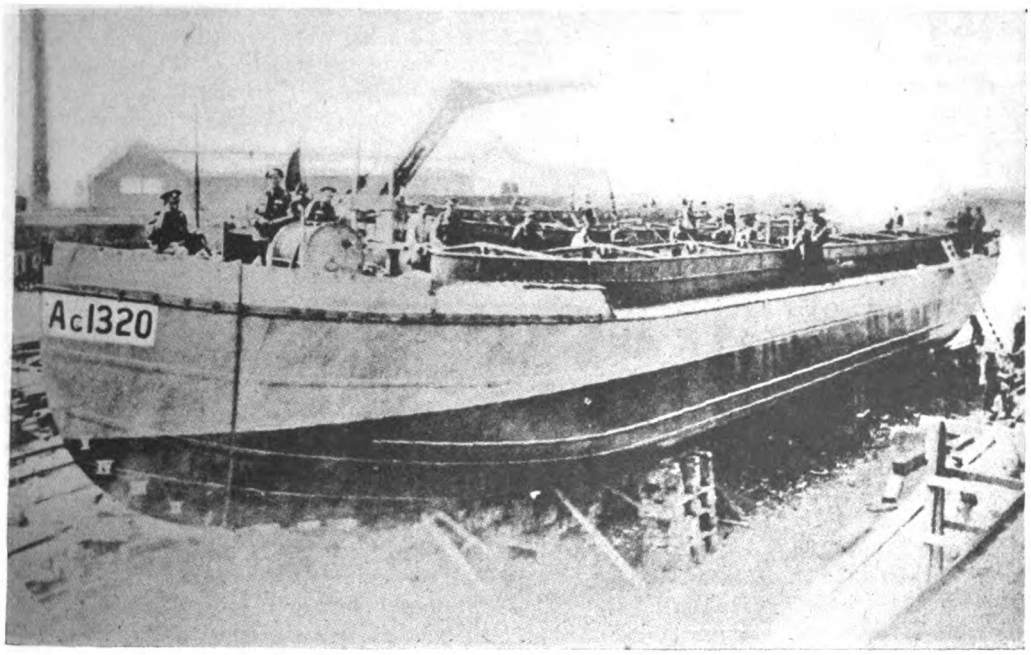

Fig. 1.—Electric Welded Barge, Built at Richborough, England

Electric Welding in Ship Construction—II*

Results of Lloyd's Tests—Tentative Regulations for Arc Welding in Ship Construction—Electrically Welded Vessels and Proposed Designs

BY H. JASPER COX

AS outlined in the January issue, a series of experimental tests was devised and carried out under the direction of Lloyd's technical staff in England, extending over a period of many months, to determine the possibilities of the application of electric arc welding to shipbuilding. The following is a summary of these experimental results:

1. *Modulus of Elasticity and Approximate Elastic Limit:*

(*a*) In a welded plate the extensions in the region of the weld are sensibly the same as for more distant portions of the unwelded plate.

(*b*) With small welded specimens containing an appreciable proportion of welded material in the cross sectional area, the relation between extension and stress is practically the same, up to the elastic limit, as for similar unwelded material.

(*c*) The elastic limit (or the limiting stress beyond which extension is not approximately directly proportional to stress) appears to be slightly higher in welded than in unwelded material.

(d) The modulus of elasticity of a small test piece, entirely composed of material of the weld, was about 11,700 tons per square inch as compared with about 13,500 tons for mild steel and about 12,500 tons for wrought iron.

2. *Ultimate Strength and Ultimate Elongation:*

(*a*) The ultimate strength of welded material with small specimens was over 100 percent of the strength of the unwelded steel plate for thicknesses of ½ inch, and averaged 90 percent for plates of ¾ and 1 inch in thickness.

(*b*) Up to the point of fracture the extensions of the welded specimens are not sensibly different from those of similar unwelded material.

(*c*) At stresses greater than the elastic limit, the welded material is less ductile than mild steel, and the ultimate elongation of a welded specimen when measured on a length of 8 inches only averages about 10 percent, as compared with 25 to 30 percent for mild steel.

3. *Alternating Stresses:*

(*a*) *Rotating Specimens* (round bar).—Unwelded turned bars will withstand a very large number of repetitions of stress (exceeding, say, 5 millions) when the range of stress is not greater than from 10½ tons per square inch tension to 10½ tons per square inch compression.

Welded bars similarly tested will fail at about the same number of repetitions when the range of stress exceeds ±6½ tons per square inch.

(*b*) *Stationary Test Pieces* (flat plate).—Butt welded specimens will withstand about 70 percent of the number of repetitions which can be borne by an unwelded plate.

Lap welded plates can endure over 60 percent of the number of repetitions necessary to fracture a lap riveted specimen.

4. *Minor Tests:*

(*a*) Welded specimens are not capable of being bent (without fracture) over the prescribed radius to more than about 80 degrees with ¼-inch plate, reducing to some 20 degrees where the thickness is 1 inch. Unwelded material under the same conditions can be bent through 180 degrees.

(*b*) Welded plates can withstand impact with a considerable degree of success; a half-inch plate of dimen-

*Concluded from January issue. Extracted from paper read at twenty-sixth general meeting of the Society of Naval Architects and Marine Engineers, Philadelphia, Pa., November 15, 1918.

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sions already quoted sustained two successive blows of 4 hundredweight dropped through 12 feet, giving a deflection of 12 inches on a length of about 4 feet 6 inches without any signs of fracture in the weld.

5. *Chemical and Microscopic Analysis.*

(*a*) *Chemical Analysis.*—The electrode was practically identical with mild steel, but there was a greater percentage of silicon.

The material of the weld after deposition was ascertained to be practically pure iron, the various other contents being carbon, 0.03; silicon, 0.02; phosphorus, 0.02, and manganese, 0.04 percent, respectively.

(*b*) *Microscopic Examination.*—The material of the weld is practically pure iron.

The local effect of heat does not appear to largely affect the surrounding material, the structure not being much disturbed at about 1/16 inch from the edge of the weld. The amount of disturbance is still less in thin plates.

The weld bears little evidence, if any, of the occurrence of oxidation.

With welds made as for these experiments, *i.e.*, with flat horizontal welding, a sound junction is obtained between the plate and the welding material.

6. *Strength of Welds* (large specimens):

(*a*) *Butt welds* have a tensile strength varying from 90 to 95 percent of the tensile strength of the unwelded plate.

(*b*) *Lap Welds.*—With full fillets on both edges, the ultimate strength in tension varies from 70 to 80 percent of that of the unwelded material.

With a full fillet on one edge and a single run of weld on the other edge, the results are very little inferior to those where a full fillet is provided for both edges.

(*c*) *Riveted Lap Joints.*—For plates of about ½ inch in thickness, the specimens averaged about 65 to 70 percent of the strength of the unperforated plate.

Typical examples of the statical strength of large specimens of riveted and welded joints are given in the following table:

TREBLE RIVETED LAP JOINTS

Thickness, Inches.	Diameter of Rivet, Inches.	Breaking Stress Unperforated Plate, Lbs. Per Square Inch.	Strength of Plain Plate, Pounds Per Square Inch	Percentage Strength of Joint.
0.49	⅞	42,400	61,400	69.0
0.53	¾	38,300	54,700	62.5
LAP WELD—FULL FILLET—BOTH EDGES				
0.514	10.02	45,300	63,600	71.0
0.73	8.76	40,330	59,600	68.0
BUTT WELD—NOT STRAPPED				
0.505	10.66	61,000	63,600	96.0
0.76	9.88	54,680	59,600	91.5

OBSERVATIONS ON EXPERIMENTAL RESULTS

1. *Static Elasticity.*—It will be observed that the statical tests made to determine the elasticity indicate that, in general, the combination of welded and unwelded material behaves practically homogeneously up to at least the elastic limit. Moreover, the experiments show that the process of welding is such that the stress is distributed practically uniformly over the weld and also transmitted uniformly to the adjacent plates.

The material of the weld is practically pure iron, and from the tests made on a specimen composed entirely of the deposited material of a weld it will be seen that for a given stress the weld stretches slightly more than mild steel. This property will enable any undue occurrence of load being transferred in a proper manner to adjacent portions of the structure. When, however, the stress exceeds the elastic limit and is so great that the extension grows continuously without increase of load, the welded material fails sooner than mild steel. But this disadvantage is of little practical importance in shipbuilding and may be regarded as negligible in the particular problem under consideration.

2. *Dynamic Elasticity.*—In a structure, such as a ship, which is exposed to variations and reversal of stresses, it is extremely important to know whether the material to be used is likely to break down rapidly under such alternations and ranges of stress as are likely to be experienced. The modified Wohler tests employed in the experiments certainly indicate, if considered solely by themselves, that whereas for a given number of alternations mild steel would withstand a range of stress of, say, ±10½ tons, the welded material might be expected to fail at about ±6½ tons, a figure which is more nearly experienced in ordinary ship construction.

As already stated, the material in the weld appeared to be nearly pure iron, and experiments of repetitive stress show that wrought iron bars are likely to fail under a range of stress of perhaps ±7 to 8 tons, as compared with mild steel at ±10 to 11 tons. The weld has to be deposited electrically and is subject to variations in workmanship; it would consequently be considered satisfactory if the material could withstand a range of stress of, say, ±6½ tons.

It would appear to be necessary to design the welded joints in such a manner that the amount of work likely to be thrown on the joint is as small as possible, and to meet such a condition a welded joint requires to be either lapped or strapped.

Consideration of the dynamic elasticity properties appears to show that in any case the welded material can experience as large a number of repetitions of stress as wrought iron could do, and it is always recognized that, although iron could not approach the tests for mild steel, yet it was a satisfactory material for shipbuilding purposes. Further, attention to design of details will increase the performance of the welded joint, and in addition it must not be forgotten that 5,000,000 repetitions of stress is perhaps more than equivalent to ten years' good sea service.

3. *Physical Nature and Properties.*—It has been mentioned that the welds experimented with are to be regarded as having been produced under most favorable conditions, and that throughout the experimental welds were made with the specimens horizontal and below the operator. In practice, welds will require to be made vertically and overhead as well, consequently extreme care will be required in such operations.

The physical examinations indicate that the materials of the electrode and the system of welding adopted were suitable and reliable. Moreover, there was little apparent oxidation, and the material in the neighborhood of the weld was not affected to any prejudicial extent.

4. *Strength of Welds and Minor Tests.*—Broadly speaking, the tensile strength of butt welds was as great as the unwelded material, but it is considered that greater reliability of workmanship is obtained with joints which are either lapped or strapped. It was also found that the lapped joint was practically as strong as a riveted lapped joint and would probably remain tight when subjected to more trying conditions than are necessary to disturb a riveted lap joint.

It will be seen therefore that the arc-welded joints made

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by highly skilled workmen with the particular system adopted throughout the foregoing experiments (the quasi arc process using flux covered electrodes) proved not only reliable but in some respects superior to the usual riveted joint. In view of the satisfactory results of these tests, the Committee of Lloyd's Register of Shipping has decided that, under certain conditions, electric arc welding may be used in the main structure of a vessel and have adopted as a tentative measure the following provisional rules for classification in Lloyd's Register Book of vessels electrically welded, subject to the notations "Experimental" and "Electrically Welded." The approval of the Society will be given to any system of welding which complies with these regulations, and consideration will be given to any alternative constructional arrangements which may be submitted for approval.

TENTATIVE REGULATIONS FOR THE APPLICATION OF ELECTRIC ARC WELDING TO SHIP CONSTRUCTION

A. System of Welding and Workmanship

1. The system of welding proposed to be used must be approved and must comply with the regulations and tests laid down by the committee.

2. The process of manufacture of the electrodes must be such as to ensure reliability and uniformity in the finished article.

3. Specimens of the finished electrodes, together with specifications of the nature of the electrodes, must be supplied to the committee for purposes of record.

4. The committee's officers shall have access to the works where the electrodes are manufactured, and will investigate, from time to time as may be necessary, the process of manufacture to ensure that the electrodes are identical with the approved specimens.

5. Alterations from the process approved for the manufacture of electrodes shall not be made without the consent of the committee.

6. The regulations for the voltage and amperage to be used with each size of electrode, and for the size of electrode to be employed with different thicknesses of material to be joined, are to be approved by the committee.

7. The committee must be satisfied that the operators engaged are specially trained, and are experienced and efficient in the use of the welding system proposed to be employed.

8. Efficient supervisors of proved ability must be provided, and the proportion of supervisors to welders must be submitted for approval.

B. Details of Construction

9. The details of construction of the vessel and of the welds are to be submitted for approval.

10. Before welding, the surfaces to be joined must be fitted close to each other and the methods to be adopted for this purpose are to be approved.

11. All butt and edge connections are to be lapped or strapped.

12. With lapped connections, the breadths of overlaps of butts and seams and the profiles of the welds are to be in accordance with the following table:

Thickness of Plate, Inches	Width of Overlap Seam and Butt, Inches	Throat Thickness, Inches.
0.40 and under	2¼	.28
0.60 and under	2½	.38
0.80 and under	2¾	.48
1.00 and under	3	.50

Intermediate values may be obtained by direct interpolation, and for thicknesses below 0.40 the throat thickness is to be about 70 percent of the thickness of the plate.

13. A "full weld" extends from the edge of a plate for a distance equal to the thickness of plate to be attached, and the minimum measurement from the inner edge of plate to the surface of weld is the throat thickness given in the table above.

14. A "light closing weld" is a single run of light welding worked continuously along the edge of the plate. Such a weld may, however, be interrupted where it crosses the connection of another member of the structure.

15. An "intermittent or tack weld" has short lengths of weld which are spaced three times the length of the weld from center to center of each short length of weld. Such tack welding may vary in amount of weld between a "full weld" and a "light closing weld."

16. The general character of welds is to be in accordance with the following table:

	Inside Edge	Outside Edge
(*a*) Butts of shell, deck and inner bottom plating.... (*b*) Butts of longitudinal girders and hatch coamings.	F	F
(*c*) Edges of shell, deck and inner bottom plating.... (*d*) Butts and edges of bulkhead plating.....	L	F
	Toe	Heel
(*e*) Frames to shell, reverse frames to frames and floors ..... (*f*) Beams to decks..... (*g*) Longitudinal continuous angles..... (*h*) Side girders, bars to shell, intercostal plates, floors and inner bottom..... (*i*) Bulkhead stiffeners.....	T	L

F = full weld. L = light weld. T = tack weld.

17. All bars required to be watertight are to have continuous welding on both flanges with tack welding at heel of bar.

18. The welded connections of beam, frame and other brackets are to be submitted for special consideration.

19. The committee may require, when considered necessary, additional attachment beyond that specified above, and the welding of all other parts is to be to their approval.

The rules are necessarily of a tentative nature and general in character and will be modified as further experience demands. It will be observed, however, that considerable importance is attached to the system of welding, type and process of manufacture of electrode, and to the employment of specially trained operators under supervisors of proved ability.

ELECTRICALLY WELDED VESSELS

The first vessel to be electrically welded so far as the writer is aware was the *Dorothea M. Geary*, a small launch 42 feet by 11 feet by 6 feet 6 inches, built by the Geary Boiler Works at Ashtabula Harbor, Ohio, in 1915. The shell, which is of 8-pound plating, is electrically welded throughout, the joints being butted, and metallic arc bare electrode used. The frames and bar keel are riveted to the shell. This little boat has been in service in the harbor since her completion, and no signs of distress or leakage have yet been noticed in any of the welded joints.

The Richborough Barge.—The barge recently completed at Richborough on the southeast coast of England, and referred to in the daily press as "the first rivetless ship," has attracted widespread attention. The construction of this barge was the sequence to a long series of successful tests on electrically welded joints carried out in England at the Admiralty dockyards and elsewhere, and will doubtless prove to be the stepping stone between the laboratory test stage and an actual full-powered ocean-going steamer yet to be built.

The barge is a non-propelled standard cross-channel transport barge, 125 feet between perpendiculars and 16 feet beam, with a displacement of 275 tons. It differs in

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no way from the standard riveted type with lapped joints, excepting that the seams of shell plating are arranged clinker fashion and joggled to permit of horizontal downward welding as much as possible. The hull is rectangular in section amidship, with only the bilge plates curved. The shell plates are ¼ inch and 5/16 inch thick.

It was erected in the ordinary manner with service bolts spaced from 10 inches to 15 inches apart, and after the joints were welded the bolts were removed and pins driven into the holes and welded up, as it was desired to complete the structure entirely without rivets.

Five welders of considerable experience were employed on the work, using the "Quasi Arc" process with flux covered electrodes. After a few initial difficulties had been overcome, an average speed of welding of 7 feet per hour was maintained, including overhead work, which averaged from 3 to 6 feet an hour. Altogether there were from 7,000 linear feet of welding and 3,066 holes to be filled, the total cost of welding, which was $14,400 (£300), made up as follows: Electrodes, $855 (£178); current, $288 (£60); labor, $297 (£62), a total of $14,400 (£300). It is anticipated that the large proportion of this amount, represented by cost of electrodes, could be reduced by some 60 percent with an increased output.

Careful check was kept of the total cost and the total man-hours of work involved, but a comparison with that of a similar riveted barge would be misleading, since the welded vessel was purely an experimental demonstration and no attempt was made to save material or to economize by the substitution of rivets in parts where this might have been cheaper or quicker than welding. Nevertheless, it is estimated that 246 man-hours were saved over the riveted barge.

Since her completion she has been engaged in cross-channel service, and with a full cargo of ammunition has experienced some exceptionally heavy weather, but has so far shown no signs of failure in the electrically welded joints.

A. J. Mason's Experimental Section.—With the object of trying out on full scale several methods of electric welding, Mr. Mason, of the United States Shipping Board, is having constructed at the Federal Shipbuilding Company's yard, Kearney, N. J., a 46-foot length of the full-size middle body section of one of the standard 9,600-ton deadweight vessels. Owing to the difficulty in securing material, some departure has been made from the regular scantlings, and ordinary tank quality steel is being used. It is proposed to employ a variety of different methods of connection, including riveting, in the different parts, and a serious attempt will be made to apply the portable spot welder, previously referred to, both for clamping and welding.

In this work, Mr. Mason is collaborating with the Welding Committee, and it is expected to derive considerable information of a practical nature during the erecting and welding of the structure by different systems. The section is arranged so that on completion it may be filled with water and subjected to hydraulic and such other tests of a practical or scientific nature which may be suggested.

Designs for Welded Ships

Two significant points to bear in mind in designing an electrically welded vessel, for the present at any rate, are, first, that we do not know all there is to know about a welded joint, and, secondly, a welded joint has not yet been produced which is 100 percent efficient in all respects as compared with the parent material united. With reasonable precautions it is comparatively easy to obtain a tensile strength at least equivalent to the metal united, but tension is only one of the many stresses to which such structures are subjected. It is not so easy to reproduce the same degree of ductility, the resistance to fatigue and to combined stresses of various kinds.

In preparing the design and arrangement of material for a welded ship, it is considered desirable to keep the following practical features in view:

1. The work has to be properly closed up for welding.
2. Overhead welding should be reduced to a minimum.
3. As much welding as possible should be done on the ground or in the shops, where the material can be handled in the most favorable positions and where the discomforts and inconvenience of protective equipments are least felt.
4. In certain parts riveting may be more convenient and economical than welding.

Longitudinally Framed Electrically Welded Vessel—J. W. Isherwood has designed an electrically welded vessel on the Isherwood system of ship construction. The dimensions are 303 feet length between perpendiculars, 42 feet 9 inches beam molded, 23 feet 4 inches depth molded, and about 3,960 tons deadweight carrying capacity. The arrangement of material and scantlings is much the same as in a riveted vessel of the same type, and apparently the designer has given full consideration to the practical limitations in ship construction, as well as to the limitations demanded by our present knowledge of electric welding.

The seams of side plating are arranged clinker fashion, and as many attachments as possible are welded to the shell decks and inner bottom plating before erection in order to reduce the amount of overhead welding. In fact, from a close study of the design, it will be seen that overhead welding is practically avoided altogether in the case of the strength welds.

The shell plates in this design are 84 inches in width and each plate has three longitudinals welded to it before erection, the butts of the longitudinals being welded at or near the butts of the shell plate. The system of construction lends itself to a large proportion of the total welding being done prior to erection, and in working out the details no attempt has been made towards an unreasonable elimination of bolting or riveting. For instance, the longitudinals are attached to the shell plating by service bolts spaced 12 inches apart and are welded at the toe and heel by continuous light welds; then the bolts are removed and rivets or welded studs fitted. In other parts, where the minimum number of bolts necessary to properly tighten up the work approaches the total number of rivets required in the riveted ship, the designer has simply added the extra rivets instead of attempting to weld.

This vessel has been designed in general conformity with the Rules of Lloyd's Register of Shipping for electrically welded vessels, and instructions have already been issued by the Director of Shipbuilding in Great Britain to proceed with the construction of a number of coastal vessels of about 200 feet in length after this design, and the 303-foot vessels will probably be commenced shortly.

Transversely Plated Vessel—It may be found desirable and expedient to break away entirely from the present methods of erection and of arranging material for which the limitations of a riveted joint have been primarily responsible. That such an eventuality has been foreseen is evidenced by a design and method of erection devised by Mr. C. P. M. Jack, acting under the direction of the Electric Welding Committee. In this design one of the principal objects aimed at was the fabrication and welding of large sections in the shops with a view to reducing overhead and field welding. With the exception of the

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keel, center keelson, rider, bilge and sheer strakes and upper deck stringer, the vessel is plated transversely. The parts mentioned are those subjected to the maximum principal stresses and are worked fore and aft in long lengths of increased thickness, the butts being shifted and specially reinforced.

The method of erection proposed is also a radical departure from existing methods. Instead of building from the keel upwards, this vessel is built from the stern forward. A large header—mounting two electrically driven cranes and containing the stagings, pipe fitters', joiners', carpenters', and other shops, welding equipment, and foremen's offices necessary—for each ship travels along the way on tracks as each 6-foot section is completed.

The design was adapted to standardized production and arranged so that a complete section 6 feet in length could be erected and welded at the ship each 8-hour shift. It was intended that the shop work be done entirely by women and the field erecting and welding by men.

Tosi Turbine-Driven Auxiliaries

STEAM turbines of simple design have been developed by the firm of Franco Tosi, of Legnano and Milan, Italy, for the purpose of driving auxiliary machinery in the engine rooms of steamers. When applied to blowers, feed pumps, circulating pumps and electric generating sets, these turbines are found to be economical in operation.

Capacity of Tosi Air Blower

In manufacturing the blower units, the turbine and blower are coupled together in compact form to simplify installation. These turbines, which are built for a working pressure of 200 pounds per square inch, may be operated with equal success with open exhaust, attached to the condensing chamber, or fitted with an exhaust pipe which furnishes a back-pressure of 20 pounds per square inch. Normal operating power is produced with a steam pressure of 140 pounds per square inch, and the turbine will accommodate an overload of at least 10 per cent. Fixed on tapered bases with tie rods, turbo-blowers of the vertical shaft type can be installed as a complete unit from the deck of the vessel. Deformations of the hull, therefore, cannot interfere with the operation of the blower. On account of the vertical division of the turbine frame, the turbine can be opened for inspection by simply loosening a few bolts without the use of special tools.

The blower, which is also built at the Tosi factory, is of the radial type, with taper-shaped blades at entrance and exit. The method of introducing the air horizontally into the boiler rooms produces very slight deviation. In specific installations the blower was run at a speed of

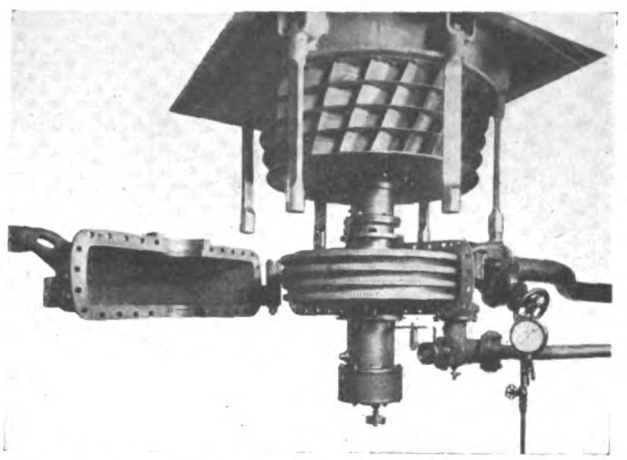
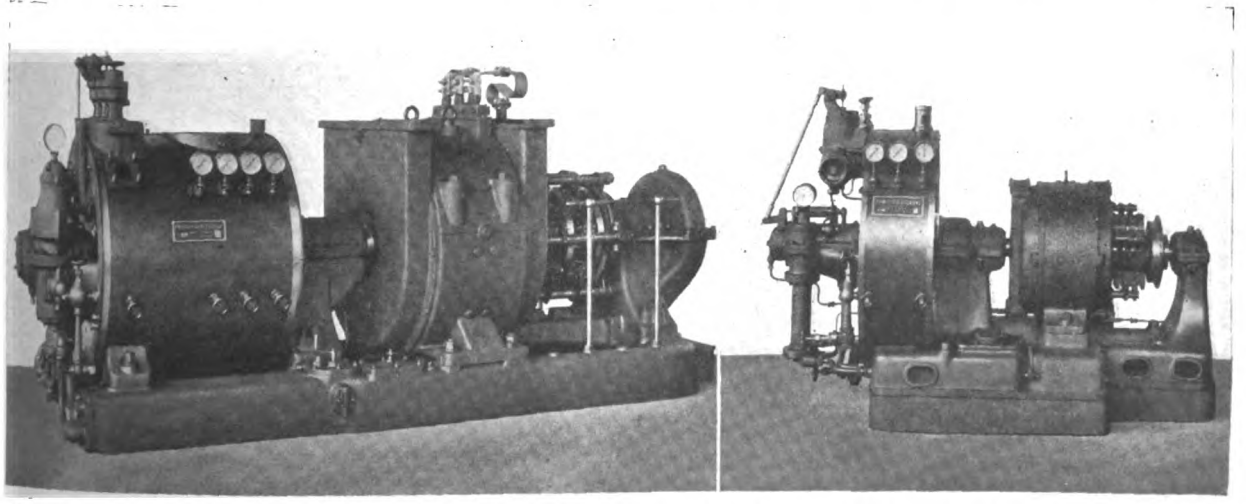


Fig. 1.—Steam Turbine for Driving Blowers Showing Simple Manner of Opening Parts for Inspection

1,500 to 1,800 revolutions per minute, with maximum air capacity of 565 to 1,130 cubic feet per second, with an air pressure of 6½ inches of water. The admission of steam is regulated by hand by means of a throttle valve. Should the turbine speed exceed 15 per cent of the normal rate, an automatic safety valve immediately shuts off the steam. For vessels of smaller type a blower of 13-horsepower has been designed which runs at the rate of 1,500 to 6,000 revolutions per minute, with a capacity of 200 cubic feet at the same working pressure as the blower of greater capacity.

Turbines For Electric Generating Sets

The weight and size of the steam turbines used for electric generating sets have been reduced to a minimum in the Tosi design. The construction of all Tosi turbines, for this purpose, which range in size from 25 to 300 kilowatts, is the same except for the blade development, which is increased for the sizes producing over 100 kilowatts.



Figs. 2 and 3.—Types of Steam Turbine Electric Generating Sets. The Larger Unit Produces 300 Kilowatts. Except for Greater Blade Development in Units Over 100 Kilowatts, the Turbine is the Same. The Smaller Unit Produces 30 Kilowatts

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Types of large and small units are illustrated in Figs. 2 and 3. Complete forced lubrication systems are installed with oil cooler and circulating pumps, replacing the older ring lubricating systems.

The dimensions of the Tosi turbine are such that the operating unit can carry a heavy overload as well as reduced steam pressure. Saturated or superheated steam may be used. Control valves for inlet steam are provided in the first wheel. All Tosi turbines are fitted with governors.

Automatic Overload Valve

As a further safeguard, the larger units are fitted with an automatic overload valve, controlled by an oil servomotor.

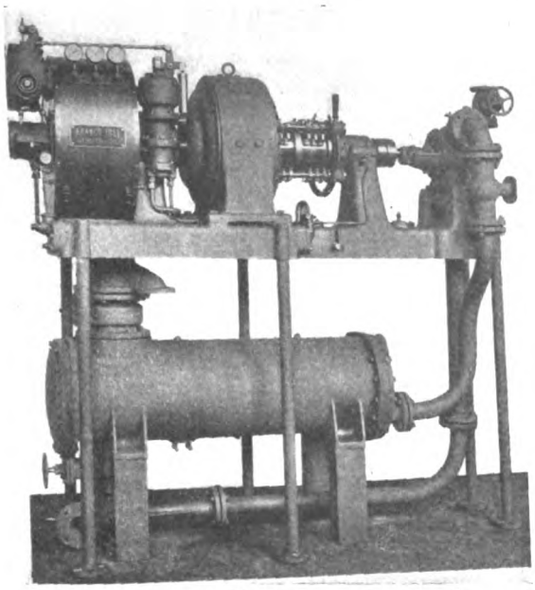

Fig. 4.—Turbine-Driven Condenser Pump, Generator Unit and Circulating Pump

The electric generators, usually of the direct-connected type, work without spark, even under very rapid change of load. Tosi turbine-driven dynamos are usually built so that one main condenser serves all auxiliaries. In cases where it has seemed preferable, each single set has been provided with its proper condenser. These generating sets are built in units, consisting of a generating set, condensers and circulating pumps for cooling water, as illustrated in Fig. 4. In these units, air pumps have been replaced by hydraulic ejectors, which provide for the elimination of all gaseous products from the condensing chamber.

Unit Group Construction

Turbines for water circulating, boiler feed, and oil circulating pumps, which are made in all current sizes and pressures, drive these pumps directly. To save floor space and simplify operation, all the necessary pumps for the condensing plant are incorporated in one unit group, which is driven by one turbine. The latter is actuated by a reduction gear which operates at a speed of 500 revolutions per minute. A centrifugal water circulating pump, with a 90-ton capacity and maximum pressure of 8 pounds per square inch, and a lubricating oil circulating pump, which furnishes the whole lubricating system of the main propelling machinery, are also included in the unit group construction.

Boiler Feed Turbo-Pumps

In addition, a vertical centrifugal pump, driven by means of a helical gear from the pump shaft, is provided for the extraction of the condensed water (Fig. 6). In Fig. 5 is illustrated a type of boiler feed turbo-pump which runs at the rate of 3,200 revolutions per minute. This pump has a capacity of 120 tons of water per hour, at a pressure of from 250 to 280 pounds per square inch. For smaller vessels, similar designs of turbo-pumps are built with capacities of 24 tons per hour and up.

Tosi Turbines Installed on Italian Naval Vessels

Reports from many of the vessels in the Italian Navy, where these turbine units have been installed, show that they have been operated with marked success in heavy war service. Exact measurements, taken during official tests at the Tosi shops, relating to the steam consumption of these turbines when driving blowers and dynamos, indicate that the fuel consumption for Tosi turbines is about 25 per cent less than that recorded for other types of steam turbines installed upon navy vessels. Practically the same working conditions are obtained in the shop tests as are found in actual operation on board ship.

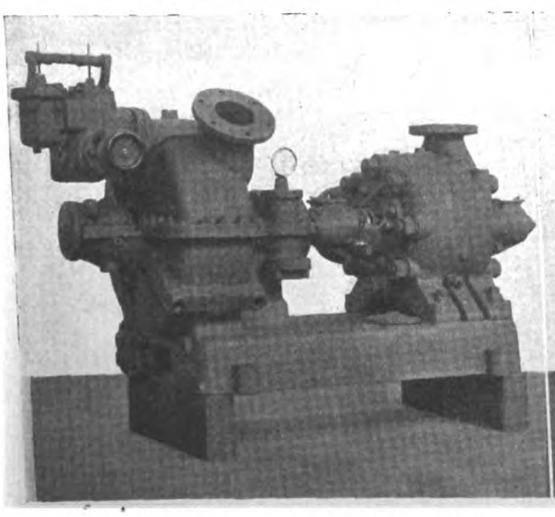

Fig. 5.—Turbine-Driven Boiler Feed Pump Having a Capacity of 120 Tons of Water per Hour at a Pressure of 250-280 Pounds per Square Inch

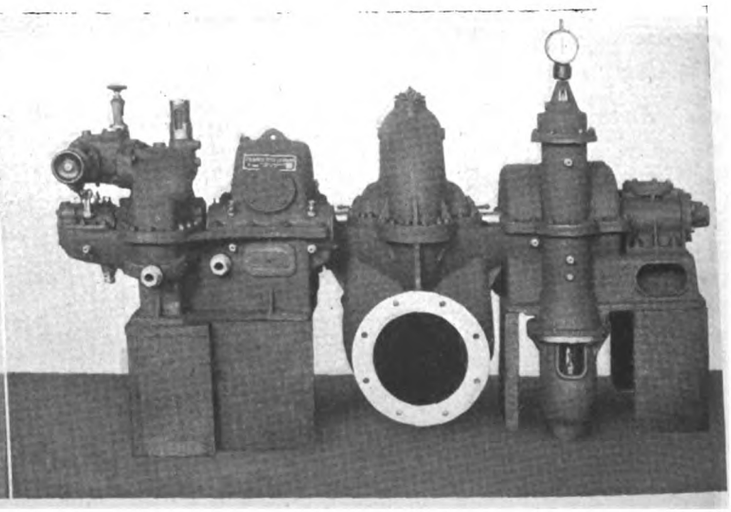

Fig. 6.—Steam Turbine for Driving a Lubricating Oil Circulator Pump and a Vertical Centrifugal Pump to be Used in the Extraction of Condensed Water

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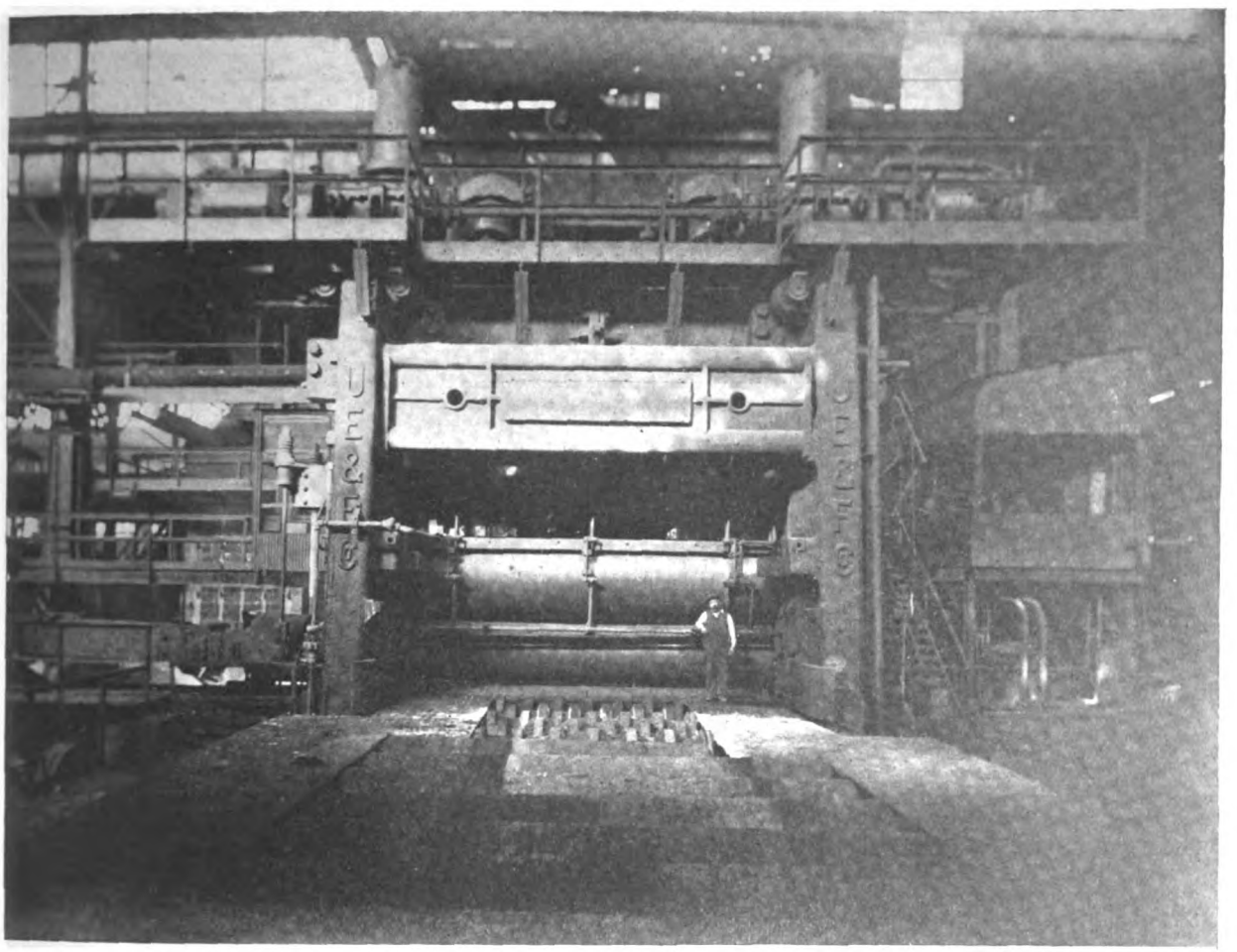

Fig. 1.—Showing Rolls of 4-High Reversing Type of Mill. The Two Cast Iron Working Rolls, 34 Inches in Diameter, Weigh 20 Tons Each. The Backing Rolls, 50 Inches in Diameter, of Cast Steel, Weigh 60 Tons Each

Lukens New Plate Mill Largest in the World

Of 4-High Type With Rolls 204 Inches Wide—New Mill Will Roll 5,000 Tons of Plate Per Week—Six Furnaces Added to Steel Plant

THE Lukens Steel Company is now operating a new 204-inch mill, which not only exceeds any unit in the United States, but also anything in any other country in the world. This mill, a 4-high reversing type, is capable of rolling plates up to 192 inches in width and circles a few inches wider.

Design of the New Mill

The new mill is built on the principle of the 2-high reversing plate stand commonly used in the British Isles, with a modification, viz., that the two finishing rolls are backed by two large supporting rolls. The purpose of these latter rolls is to stiffen the mill and to give it the added strength necessary to prevent springing of the operating rolls when rolling wide, thin plates, thus insuring uniform thickness in the finished product. This arrangement also enables the use of operating rolls of smaller diameter, and thereby overcomes the difficulties of obtaining chilled rolls of the size which would be required in a 3-high mill of this extreme width. There are two 34-inch diameter by 204-inch working face operating rolls of chilled iron with 27-inch necks weighing about 30 tons each, and two 50-inch diameter backing rolls of cast steel with 36-inch necks, weighing about 60 tons each.

The housings of the mill are of steel and are built up in four parts, consisting of two side pieces—a top bridge piece containing the screw box, and a bottom bridge piece in which is located the seat for the bottom rolls. This novel method of construction is necessitated by the unusual size of the housings, which preclude their being cast in one piece, since their machining and transportation in such form would be impossible. Each housing thus built up weighs over 400,000 pounds. The mill stands about 40 feet from the top of the screw cover to the bottom of the shoes, and its overall dimensions are slightly over 42 feet. The housing shoes are spread 16 feet 9 inches between centers and are of special design with extra large bearing surfaces.

The foundation of the mill is of concrete built on solid rock. The mill pinions are of cast steel and have double helical cut teeth, 42-inch pitch diameter by 60-inch face. The bottom pinion is connected to the engine jack shaft by a finely machined leading spindle of the universal type. This leading spindle is so arranged that it can be quickly removed and a slow-motion turning rig slid in place to be used in dressing the 50-inch backing-up rolls. The mill has a slack-up of 40 inches.

The mill is driven by a 46 by 70 by 60-inch twin tandem

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compound condensing engine, fitted with a jack shaft and a gear ratio of one to two, which renders it capable of giving an enormous torque for rolling wide plates.

Process of Rolling the Plates

The mill is fully equipped with tables so arranged as to do away with hand labor wherever possible. The ingots are received from the furnaces by a hydraulically operated ingot tilter, from which they go to the approach table, and from there to the mill tables. The approach table is about 40 feet long; the mill tables are of about equal length. Each mill table consists of ten cylindrical rollers and five disk rollers. These rollers are driven by cut gearing, and the bearings and gearings are flood lubricated by an oil-pumping system, which is installed in duplicate. These tables are equipped with mechanical appliances for handling large plates, so that it is not necessary for them to be touched by hand power, as is usually the case in other present-day mill practice.

Cut-Off Shear with 210-Inch Gap

After inspection, the plates proceed to the shear run-out table through the cut-off shear, which is hydraulically operated and has a 210-inch gap. The cut-off shear is located in the shearing building, as is also the side shear, which is of the same size, and the necessary scrap shears. Between these shears are located tables specially designed by C. L. Huston for the handling and turning of wide, long plates. These take the place of the usual caster roller arrangement, avoiding hand labor. Another set of transfer chains carry the plates sidewise to the shipping building, where they are weighed and loaded.

Since it is possible to roll ingots up to 60,000 pounds in weight, all the machinery is constructed with a view of handling these heavy plates. These large plates are rolled direct from the ingots, but, since this has always been the practice in the Lukens plant, no serious trouble is experienced from this. When the mill is operating at its full extent, it is estimated that it will have a rolling capacity of 4,000 to 5,000 tons per week. The new mill is known as the No. 5 mill and is located parallel to the present 140-inch 3-high plate mill. The position of the two mills and the arrangement of the tables permit easy transfer of hot ingots between these two units by means of a transfer buggy. By this arrangement, ingots can be drawn from the No. 5 mill and rolled in the 140-inch mill, or vice versa.

New Steel Plant to Furnish Material

To supply the increased metal to operate the new mill, an additional steel plant comprising six basic open hearth furnaces of 100 tons each has just been finished. There is room for two more furnaces, work on which has been started. Including this group of eight furnaces, which presents a distinct open hearth installation, the Lukens plant will consist of twenty-three basic furnaces and one acid furnace. The estimated annual capacity will be about 500,000 tons of finished plates.

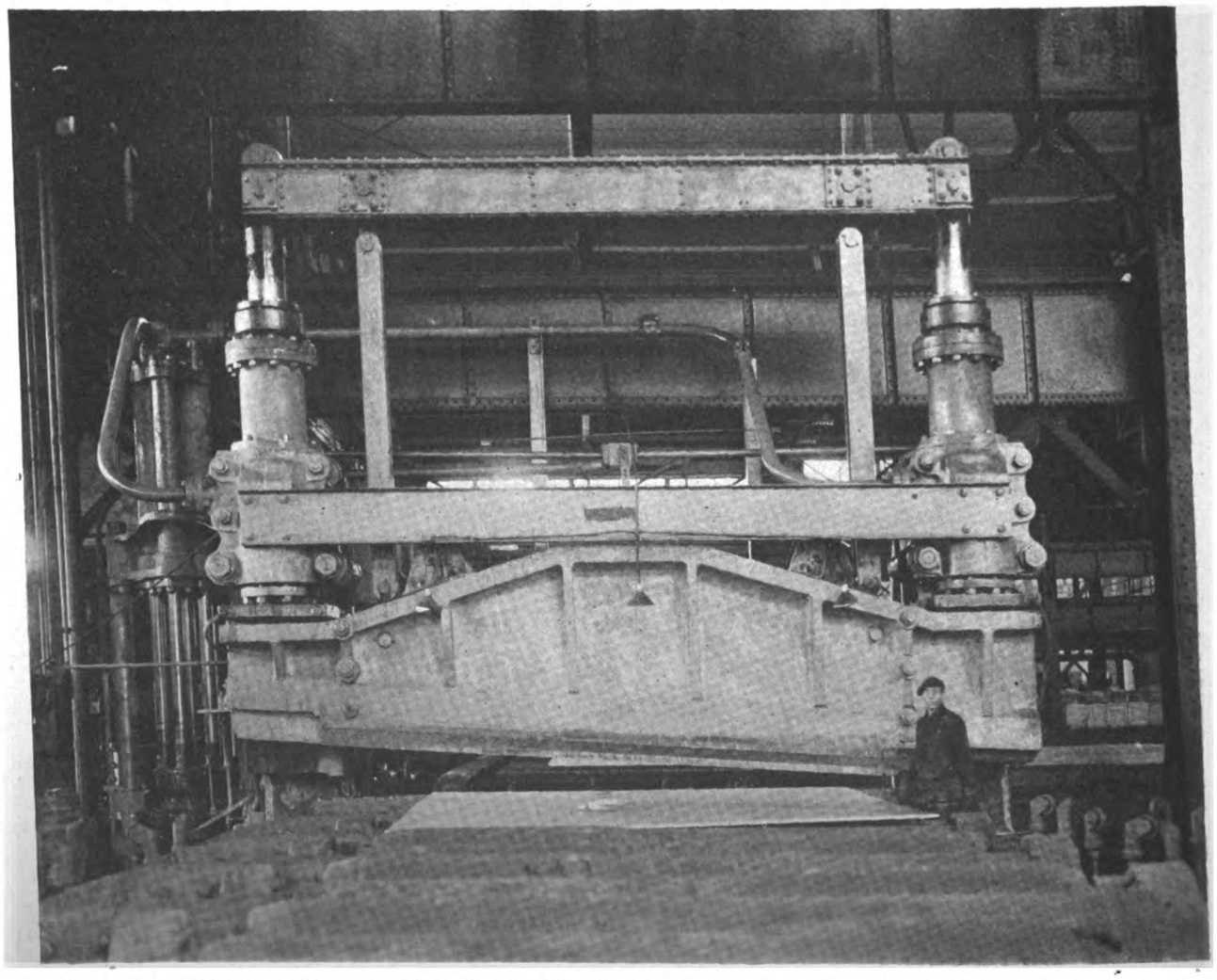

Fig. 2.—View of Hydraulic Shears Capable of Shearing Material 2 Inches Thick. The Knife is 215 Inches Long; Shears, Between Housings, 210 Inches

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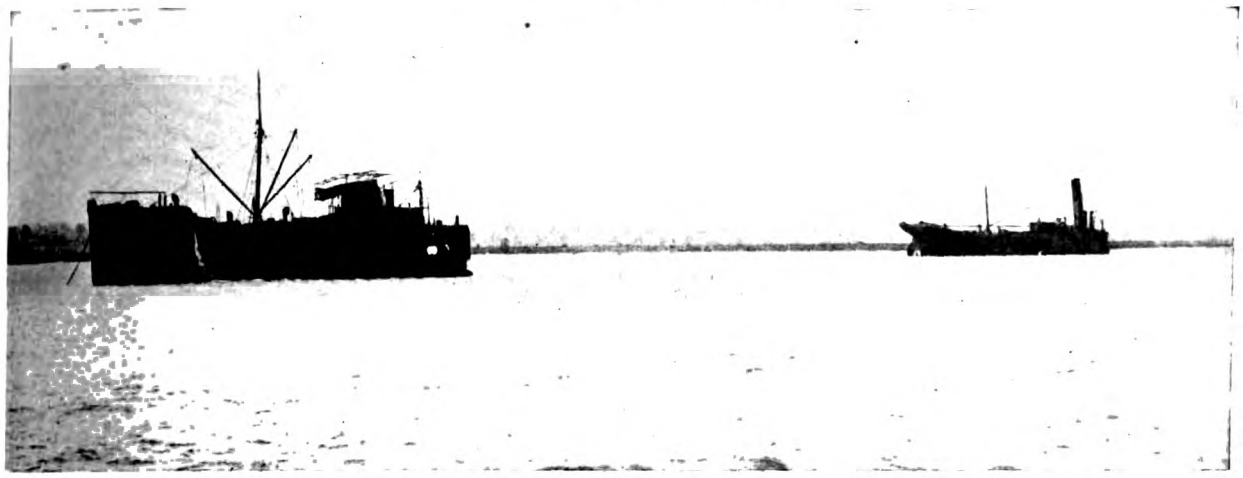

Fig. 1.—The Steamship *Araby* When Partly Salvaged

Interesting Salvage Work

AN interesting piece of salvage work was recently completed by the Salvage Section of the British Admiralty. The steamship *Araby*, of about 3,300 tons register, bound from the Argentine with a cargo of oats, ran aground on the French coast on December 21, 1916. The vessel was refloated on December 23, and while being assisted into a harbor, then very busily engaged on war service, the towing hawsers parted. The forepart of the steamer ran up on to one of the harbor piers, and the after end on the other pier, causing the ship to become firmly fixed fore and aft athwart the harbor entrance. A few hours later the steamer broke her back near the stokehold bulkhead. The stokehold, engine room and No. 2 hold filled rapidly, and the water also gained access into Nos. 3 and 4 holds. The vessel's decks, with the exception of the poop and forecastle decks, were submerged at high water.

Ship Breaks in Two

In view of the great national interest involved, salvage operations were commenced immediately, the wreck being subsequently lifted partially by camels and partially by pumping, and taken up harbor. The *Araby* then broke in two, being held together only by a few deck plates, etc. These plates were cut apart by oxy-acetylene gas, and, the two halves filling, they settled down on an even keel. By January 18, 1917, both halves were refloated and beached each side of the harbor clear of all traffic.

Pending opportunity to remove the two portions of the wreck they were allowed to lie in this position until last summer, when the space occupied by the wreck was required urgently by the military authorities. Steps were then taken to remove the wreck. In the meantime the two halves of the vessel had been made watertight by the erection of concrete bulkheads at the after end of the fore-hold and the fore-end of the after-hold.

Rebuilt on the Thames

In July the two halves were prepared for sea. By August 15, both halves were refloated, and were towed across the Channel to a repairing yard on the Thames, where preparations subsequently were made to reconstruct the ship.

German Camouflaging

BY CARL E. PETERSON

With the armistice signed and censorship on the less important factors of the war removed, interesting facts about German methods of warfare are continually coming to light. In the accompanying illustrations are shown for the first time measures which were taken by German officers to camouflage German merchant vessels. This may be considered an unusual feature of the deceptive art of camouflage as it was practiced.

Fig. 1 shows a merchant vessel which has been so successfully handled that at a distance it almost appears like a square block. As may be noted, the smoke stack and masts have been cut down to a minimum and the open spaces which would appear between the bow, the foremast and the smoke stacks have been filled in with canvas. The position of the canvas at the after part of the vessel is arranged to simulate an old Dutch sailing vessel.

Profile Disguise

An interesting disguise, which was placed fore and aft to dim the exact outlines of the ship, is shown in Figs. 2 and 3. This consisted of a boom which was fitted with lengths of manila rope hung from the guys at regular intervals. This device made it possible to blend the vessel into the horizon so that it had little or no visibility at a very slight distance.

Probably the cost of fitting out this type of camouflaged vessel and the questionable practicability of the design prevented further adoption of this method, since few

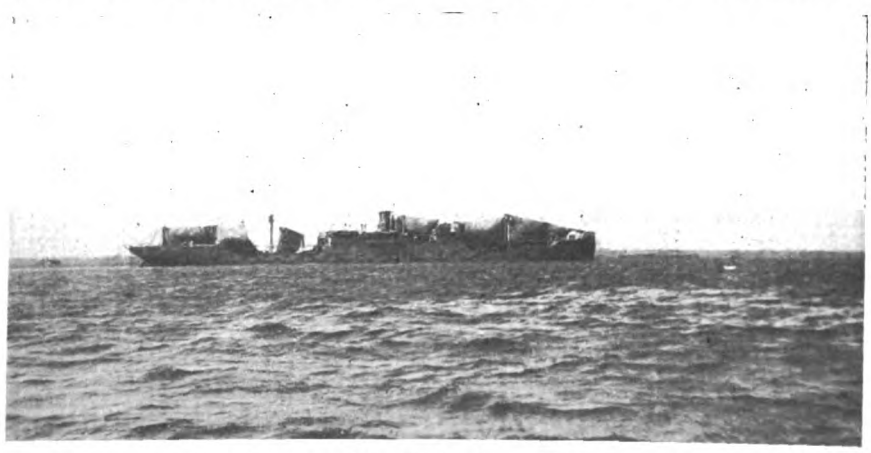

Fig. 1.—German Vessel Camouflaged by Cutting Down Masts and Smokestack and Filling in Profile with Canvas

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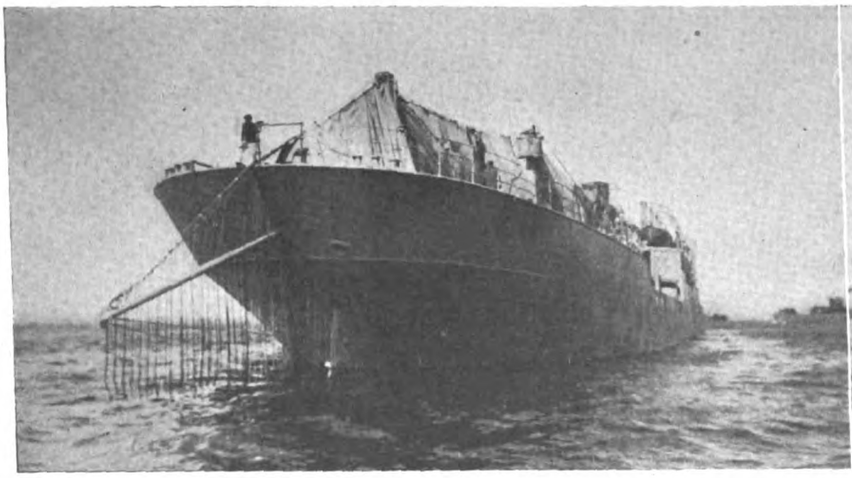


Fig. 2.—Rope Curtain Aft to Destroy Visibility of Ship Profile

Fig. 3.—Rope Curtains at the Bow of the Ship to Break the Hard Lines of the Profile

other ships carrying German seamen are known to have used this type of camouflage.

Side-Launching of Concrete Barges at the Aberthaw Yard

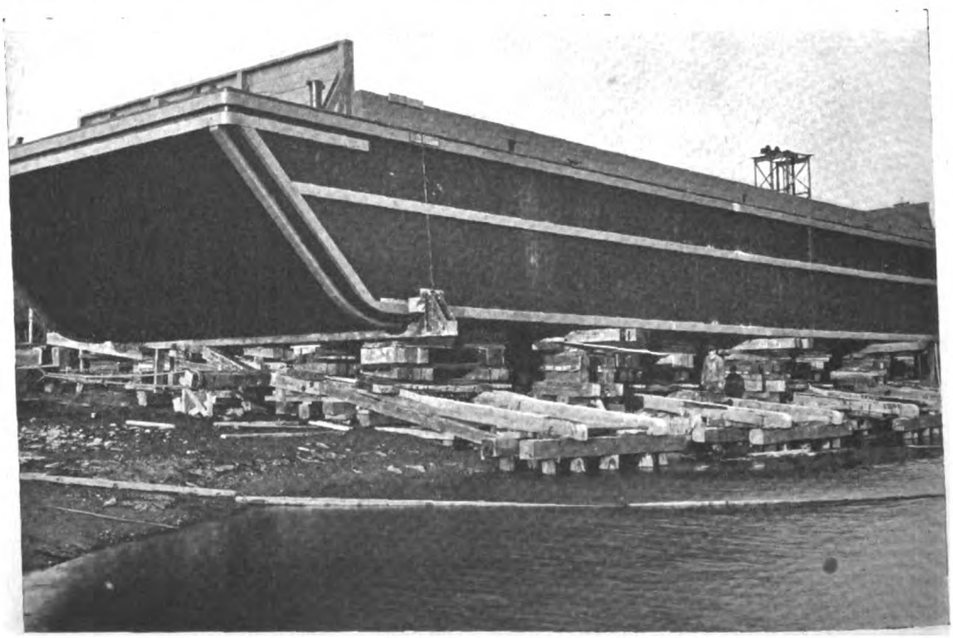
THE side-launchings on December 7 and 21 of concrete vessels built at the Aberthaw Construction Company's shipyard, Providence, R. I., mark a departure in the history of New England shipbuilding. Only once before has the method been employed in this section of the country. The comparatively shallow depth of the water in front of the launching ways and the possibility of more economical handling of concrete work with the adoption of side launching, determined the engineers in their choice of this rather unusual method.

Details of the Construction of the Ways

The four launching ways of 12-by-12-inch yellow pine, built at medium high-water level, with the outer ends just awash at high tide, were set at an incline of 1½ inches in 12 inches. These ways rested on sills laid in trenches in the ground, the outer ends being supported on piling. Each pair of ways, the outside measurement of which was 9 feet, were set at an interval of 24 feet between centers. Across each pair of ways, under each longitudinal bulkhead in the lighter, and under the center of each watertight compartment, was placed a slider carrying the wedges and blocking.

The outer unit of each pair of ways, at either end of the lighter, constituted the trigger way. This was extended to the rear and capped with a piece of yellow pine to afford a bearing surface for the base of the jacks used to "start" the vessel on the ways. The trigger ways were reinforced by two one-inch round steel bars, fitted with turnbuckles and running back to deadmen, which also served as anchors for the blocks and tackle which formed part of the releasing gear.

At either end, under the lighter, and outside of the trigger ways, was placed a shoe of 10-by-10-inch yellow pine, fitted at one end with an eye at the other, with a lip, which set against the bilge of the lighter, holding it on the ways after it had been lowered to launching position. A half-inch wire rope ran up to the deck of the lighter from either end of the shoe, holding the latter snugly in place. A strut ran from a recess in the under side of the shoe to the inner end of the trigger bar, a piece of oak 10 inches by 10 inches. The outer end of this was strained back by a 6-inch manila rope, doubled and made taut by a block and tackle running to the deadman in the rear of the launching way. The block was connected to the 6-inch cables by a double strand of 4-inch manila rope which passed over the cutting block. On the other side of the trigger, and just inside of the strut, was placed a dog shore, 8 inches by 8 inches, which butted against the piling on the outer end of the launching way. Directly



View of Concrete Barge Ready for Launching at Providence Yard, Showing Construction of Launching Ways

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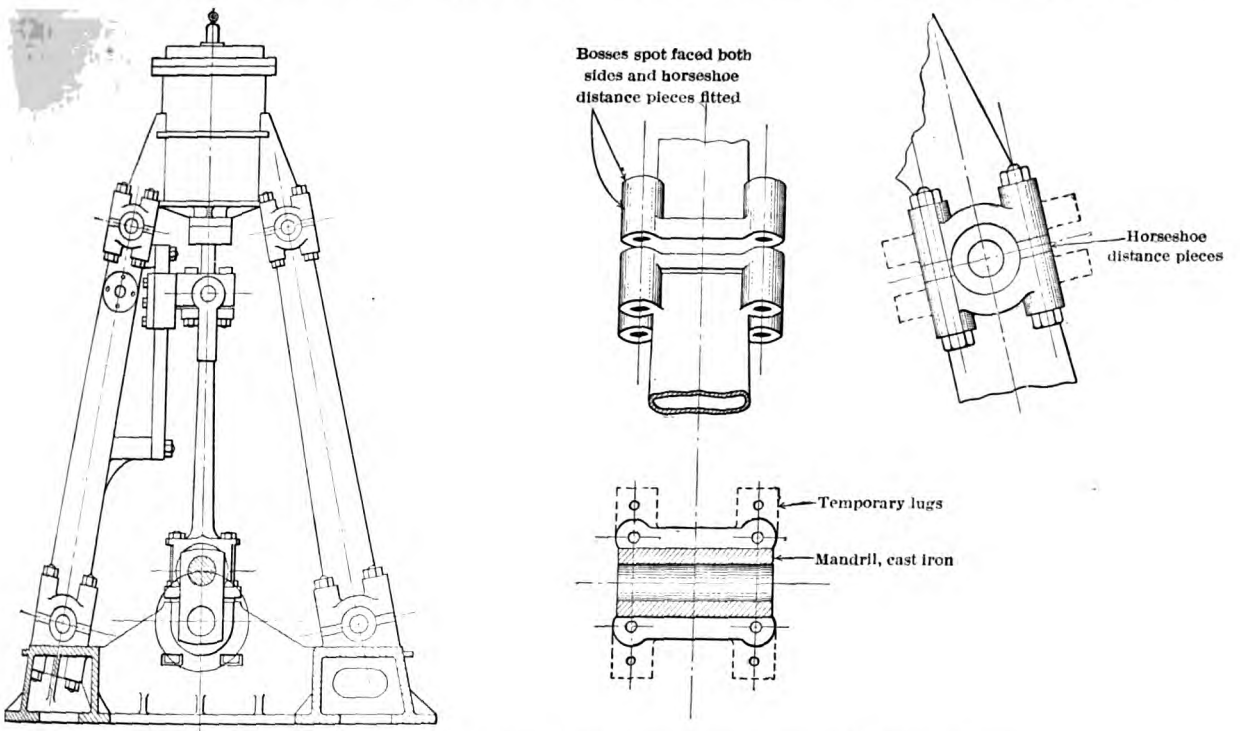
under the side of the lighter and resting on the launching ways was a tumbling block, beveled at either end, which fell clear when the vessel started down the ways.

THE LAUNCHING

After the form work had been removed, the barge was lowered with building movers' jacks to the blocking on the sliding ways, where it was kept in place by the shoes until the releasing gear was severed simultaneously at the cutting blocks. As noted above, the strain was taken by the manila cables attached to the trigger bars, and the deadman in the rear of the trigger ways. The resistance of the vessel as she struck the water broadside was sufficient to arrest the momentum, no rope stops being necessary.

These concrete lighters of 500 tons burden are 112 feet over all, of 34-foot beam and 11 feet 6 inches deep; the draft, when the lighters are empty, is 3 feet 9 inches. The Aberthaw Construction Company has under way plans for the construction of 1,000-ton barges. The building of self-propelled concrete vessels at the Providence yard is also contemplated.


Bosses spot faced both sides and horseshoe distance pieces fitted
Horseshoe distance pieces
Temporary lugs
Mandrill, cast iron

Details of New Design of Framing for Marine Reciprocating Engine to Facilitate Erection

New Method of Erecting Marine Reciprocating Engines

BY K. M. WALKER

ONE of the greatest handicaps that this country has had to deal with in meeting the present unprecedented demand for ships of all sizes and materials has been the difficulty experienced in obtaining main propelling machinery. In attempting to overcome this handicap, many and varied new methods have been devised to save labor, time and material in the construction of marine machinery and in the aggregate these new methods have resulted in a distinct saving all around, but even yet the demand far exceeds the supply.

If it were not for the fact that it has been generally considered necessary by engine builders to have large machine tools to handle and machine the heavy castings that form the bedplates, columns and cylinders of marine engines, a great many comparatively small shops without large machine tools would now be engaged in building this type of machinery.

It was this very condition that led to a new type of construction being evolved by a practical Pacific Coast engineer, in which the need for heavy machine tools is done away with.

The primary object of this method of construction is the ability to make a perfect metal-to-metal fit of the main portions of the engine to insure rigidity, a vital factor in marine engines, and a permanent alinement which cannot be disturbed, due to the fact that there are no undue stresses set up in the castings by pulling together faces which are not parallel.

The time required in erecting the main portions of the engines would be reduced to a minimum, therefore the cost of this work would be substantially reduced, and as the larger machine shop tools are unnecessary for this purpose, the building of marine engines would come within the scope of the smaller shops, which hitherto have been unable to attempt it; their only limit, using this method, being their capacity to rig gear for lifting the parts into position.

The most necessary equipment would obviously be boring bars and heads, which are usually made right in the shop. In boring the column heads and feet for their respective mandrels, it is not necessary that the centerline be parallel with the centerline of the engine; this, then, allows of a little more leeway in any direction for a distorted casting. For holding up the bars, the ideal arrangement would be angle plates to take in all centers, or failing this, either concrete uprights with adjustment boxes or the mounting of bearing boxes and driving gear directly on the engine columns.

In erecting the engines, all the castings, cylinders, columns, and bedplates are bolted together with bolts and

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wedges, the latter being for lining up preparatory to boring for the mandrels. The bore of the cylinders should be completely finished before erection.

After the engine is lined up, wedged by steel wedges driven between cylinder foot and column flanges, and bolted down solidly by bolts through the temporary lugs shown in the sketch the boring bar is inserted and all columns are bored out in line to a certain gage. A cylindrical cast iron mandrel is inserted in the bore when completed.

The column bolt holes are then drilled and reamed and spot faced as shown in the sketch. Small washerlike distance pieces are made to fit between the flanges, and when the mandrels are in place and flanges bolted down the small temporary lugs on the columns are chipped off. The heavy castings are then held rigidly in perfect alinement, with no undue strains set up which are liable to cause breaking.

In machining the sides for main journal boxes, gang cutters may be used, after the bottom is bored, being raised or lowered in the same way as a planer rail with bevel gears and screws. The machining of the facings for the reverse shaft brackets is done last and must be true with centerline of engine, and at the right height. The column facings for the reverse shaft brackets should be cast in true line horizontally with a hole cored through the center to take a boring bar, by means of which the facings are machined. By machining these brackets completely in the lathe, or boring mill, and leaving a small spigot to center them, they will be in alinement without further floor work, needing only to be raised to the correct height when the dowel pin holes are drilled. The thrust block, if designed to bolt against the bedplate, could be spigotted in the same way, and bolted into place without the usual lining up and fitting.

Again, in boring for the valve stem guide brackets, four of these brackets could be cast together, machined in the lathe with spigot parted, bolted into position, being in alinement at once. In fact, a large proportion of the machining could be done in this way, and a very great saving of time effected.

If the engine is designed to suit the tools at hand instead of designing it haphazard fashion, as is usually done, leaving the machine shop foreman to get over the difficulties as best he can, rather than throw away the casting, as often happens, very much time, labor and material could be saved.

New Lights on Economic Aspects in the Engineering Field

An evidence of the close relation which exists between the problems of business administration, employment and co-operative planning and production among competing industries, and the more technical work of the engineer was brought out by the selection of subjects handled in the papers read before the annual meeting of the Society of Mechanical Engineers, December 3 to 6, 1918.

Several years ago a wise man brought out the idea that the technical engineer with appreciation of the business and economic factors involved in government administration would make the most valuable public servant the country could employ. His ability as mayor of cities was taken as a point in question.

By extension of the same reasoning, the engineer should be best fitted for a position of chief executive in a large business undertaking. His prominence in war production has also demonstrated this. In fact, his insight into the alive facts of competent business management as evidenced by the following abstracts shows that he has come into his own.

Why has the word efficiency, which should stand for so much, fallen into disrepute in this country, is the question answered by H. L. Gantt, in his remarks before the society. We all recognize the importance of both individual and collective efficiency. Yet in the mind of the average business man or mechanic the term "efficiency engineer" raises a feeling of hostility. To some of us the reason seems plain, simply that we have in the past measured the "efficiency of our business" by the dollars acquired, rather than by the goods produced. In other words, the efficiency engineer has served the business system primarily in the accumulation rather than in the production of wealth.

A business system bent on the accumulation rather than on the production of wealth, which would even curtail the production of wealth if thereby a larger measure could be brought into its own coffers, must needs finally run to the limit of its tether. A method which makes more efficient such a system shortens the time which it has to run. An efficiency engineer who, consciously or unconsciously, served the business system in the exploitation of workmen, necessarily got the ill will of the workman. He later got the ill will of the business man, who found that the amount of wealth he could get by exploitation was strictly limited.

When the great war broke out in 1914 it became evident that the production of goods for the benefit of the community, and not the production of wealth for the benefit of those who control the industries, was the task which had been set the nations engaged. It took England more than a year to learn this lesson, and we should have been fully prepared for it in 1917. That we were not prepared for it, and that many believed we could still continue business as usual, is now history. We have learned, however, that production for the benefit of the community was the only basis on which we could carry the war to a successful conclusion. This has been emphasized by the elimination of "non-essential" industries.

There is another reason why the term efficiency has been brought into disrepute. In the past our cost-keeping methods have always loaded onto the part of the shop which produced the goods the total expense of the shop, including the part that was idle. The term "efficiency" then seemed to have no connection with capital or invest-

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ment, but only with labor. Under such conditions there was but little inducement to the owner to make his machines produce more, and the reverse of an inducement to the workman, who was thereby laid off or saw his friend laid off. This fatal error which caused the opposition of the workman, and the lack of sympathy on the part of the employer, was evidently due to a false accounting system, which was devised to put all the burden of inefficiency on the workman.

When the great war started in 1914 it became impossible for the product turned out to bear the expense which had previously been distributed over a production three or four times as large; most people said, "These are extraordinary times; therefore we shall have to lay our cost system aside to keep till the war is over." Some people, however, realized that a system which is not good for an emergency, when it is most needed, has something radically wrong about it. This was the answer: The product of a factory must bear only the expense used to produce it. It cannot bear the expense of idle machinery which did not contribute to its production. The keener business men have realized that idle capital is no more entitled to wages than idle labor, and have begun seriously to study their plants to find out how they can use them to their full capacity. The result of this investigation is twofold:

(a) It does not result in laying off men, but gives employment to more men, which secures the good-will of the worker.

(b) It not only reduces the expense of maintaining machinery in idleness, but turns out a greater product from which revenue is gotten.

In a few words, then, if we will eliminate our false cost-keeping methods, and put in those that are correct, we shall not only benefit both employer and employee, but go a long way toward the democratization of industry.

Labor Dilution as a National Necessity

Not only in the field of efficiency has war acted as an educator. Its schooling is catholic. That the term "labor dilution" originated in England shortly after the declaration of war with Germany was brought out in a paper by Frederick A. Waldron. Its original application was intended to carry out in effect what the word "dilution" literally implied; namely, a thinning or spreading out. As applied to labor, it means the thinning out or spreading of the functions of the skilled workmen among those that are less skilled. A Bureau of Labor Dilution was therefore established by the Government to supervise and carry out its requirements.

The original objective of this bureau was to relieve the skilled workman in the performance of certain elementary functions of a task by employing less skilled workers for this purpose and thereby accomplishing a given task in a shorter time. This bureau has created an element in labor dilution which was not included in the original programme in that it has already established in the minds of the consumer the fact that waste of labor and materials is the greatest foe to labor dilution. It is the engineer who must solve this problem in a scientific and satisfactory manner.

Ultimately it must be "the survival of the fittest." A nation's industries must be those for which it is particularly adapted; they must be conducted in the most economical manner, and facilities for vending and transporting their products must be on an equally economical basis. For products of equal quality, those having the lowest unit costs will naturally maintain commercial and industrial supremacy. The nation, therefore, which can deliver to the consumer its converted natural resources in the minimum time with the least expenditure of human energy is the nation which will lead the industry and commerce of the world.

This will involve the engineering of men and materials in the broadest sense. To accomplish this means a most broad and comprehensive national policy in the organization of our legislative, banking, business, agricultural, transportation, mining and manufacturing policies.

Labor dilution, as a part of the reorganization problem, should include the questions of the functionalizing of the work of the skilled operative for the less skilled operative, the eliminating of all work except that which is absolutely necessary to produce the results, and the economizing in the use of the necessities of the day.

After discussing the post-war problem of the scarcity of unskilled labor, due to cessation of immigration and the return of so many foreigners to Europe in war service and for reconstruction work over there, Mr. Waldron held that standardization of products and processes, aided (1) by co-operation of legislators, engineers, capital and labor, (2) by elimination of non-essential effort for compiling statistics, office and administrative work and of the non-essential citizen—the idle man—and (3) by education of executives and workmen so that the *fullest use of all the available man power would be possible*—all these factors would bring about results in this reconstruction period.

A study of the problem indicates that, in its broadest meaning, labor dilution and the engineering of men are practically synonymous, since the former involves all that the latter implies.

British Engineering Standard Association

The subject of standardization was very ably handled by C. Le Maistre, secretary of the British Engineering Standards Association. It may fairly be said that the primary objects of standardization are to secure interchangeability of parts, to cheapen manufacture by eliminating the waste of time and material entailed in producing a multiplicity of designs for one and the same purpose, and also to expedite delivery and so reduce maintenance charges and stores. In 1901 the British Engineering Standards Committee was founded. From the small nucleus of seven members, a far-reaching organization has developed with some 160 committees, sub-committees and panels, including in all over 900 members, and dealing under one central authority with standards relating to practically the whole field of engineering. The British Engineering Standards Association has provided the neutral ground upon which the producer and the consumer, including the technical officers of the large spending departments of the Government and the great classification societies have met and considered this subject of such vital interest to the well-being of the engineering industry of the country.

The standardization of steel sectional material was the first work taken up by the committee. The British standards for this material, so important in the construction of ships, bridges and underframes for railway wagons, have had a very wide adoption. The total number of sections is some 175, and the recently formed Mercantile Section of the Admiralty, as a war measure, was able to select from this list a largely reduced number and so put into operation an exceedingly economical measure with but little delay. The testing requirements of Lloyd's Register and the other great classification societies and the Board of Trade have been unified through the work of the committee.

It would appear from the steelmakers' returns for 1913,

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giving the tonnage of lengths rolled of each section, that 95.7 percent had been produced by standard rolls, and only 4.3 percent by non-standard rolls, the work thus having proved of immense utility to the steel makers.

In regard to the question of finance, the funds for carrying out the work of the committee have been provided by the Government and the industries concerned. In 1903 the Government included in the estimates a substantial contribution, which was subsequently extended for the years 1904-5-6 by a grant-in-aid equal to the amount contributed by the supporting institutions, manufacturers and others. This was continued on a smaller scale down to 1916, and a further grant on the same condition is being continued to March, 1919. The Indian Government has been a generous supporter of the committee, and the governments of other overseas dominions have also given financial assistance.

Members of the Governing Committee

The Main Committee, as the governing committee is called, consists of members nominated by the leading technical institutions, viz., the Institutions of Civil Engineers, Mechanical Engineers, the Iron and Steel Institute, the Naval Architects, and the Institution of Electrical Engineers; there are also two representatives of the Federation of British Industries; and three members, not representative of any institution or association, but elected for their eminence in the profession.

The Main Committee is the sole executive authority, and all specifications and reports are presented to it for final adoption. The procedure before embarking on any new subject is to ascertain by means of a representative conference that there is a volume of opinion favorable to the work being undertaken. If such is the case, the Main Committee nominates the chairman of a sectional committee to take up the work in question, this committee being formed of technical officers, representatives of the various Government departments interested, representatives of the trade organizations concerned, and, lastly, experts in the subject to be dealt with.

The most recent addition to the association's activities is that of the standardization of the details in the construction of ships and their machinery. A conference recently convened at the instance of the Board of Trade, and representing Government departments, shipowners, shipbuilders and engineers, classification societies and consulting and naval architects, has unanimously decided to recommend to the Main Committee the setting up of a complete section to deal with this branch of engineering, in which, in common with all others, economic production, fostered by interchangeability of detailed parts, is of such vital importance.

Standardization, after all, is no more and no less than proper co-ordination. To effect it may necessitate the sinking of much personal opinion, but, if its goal, through wideness of outlook and unity of thought and action, is the benefit of the community as a whole, standardization as a co-ordinated endeavor is bound increasingly to benefit humanity at large.

Employment of Labor at Hog Island

America's most colossal experiment in standardization of product is exemplified by the fabrication of standard ships at Hog Island, hence the details of the employment of labor there as presented by Dudley R. Kennedy are very closely related to the problems of efficiency, labor dilution and standardization already discussed.

In the inception of the job when the engineering estimates were in preparation, it was recognized that the labor problem would be one of the cardinal difficulties of the undertaking. Notwithstanding the difficulties, there were upon the payroll on January 19, 1918, 26,700 men, and there are now 35,000 employees. To obtain this number and maintain the necessary interim quota it has been necessary to hire a few more than 230,000 people in a calendar year. This means a labor turnover of nearly 700 percent.

The management, appreciating the size of the human engineering phase, organized a department styled the Industrial Relations Department, having jurisdiction over the branches, Employment, Medicine, Surgery, Sanitation, Safety, Housing, Feeding, General Welfare and Service and Compensation.

The manager of Industrial Relations ranks, with equal authority, with six other heads of departments, reporting direct to the president. This is an important point, as many companies now appreciate the importance of the human machine to a degree which places an executive in charge of Industrial Relations with authority paralleling that of executives in charge of other major phases of administration. This department occupies a two-story building 251 feet long by 48 feet wide, with an ell 132 feet long by 63 feet wide. The employment department occupies the bulk of the first floor. The building was planned to afford as nearly a stream line or continuous process as possible through the various stages of the necessary employment routine. Immediately the applicant for employment finds for himself a place in one of six lines, formed before six doors, over each of which appears the name of the positions or jobs for which men are being examined in that "interviewing room." There, a man familiar with the specifications of the job for which he is selecting applicants gives a short, courteous, but adequate and firm catechising, and determines the applicant's fitness for the position which he seeks.

Progress of the Applicant Through the Yard

Having accepted the applicant, he passes him on to the registration clerks, who fill out a registration blank covering the many details which it is necessary to record for purposes of identification, for the State Workmen's Compensation Law, for the Selective Draft and for statistical purposes. This form, when completed, is handed the man and he proceeds to the physical examination, where he enters one of thirty booths and receives an examination in the nude to determine his fitness for work and for the particular job to which he is assigned.

Successfully passing this examination, the applicant proceeds to the photographic room, where he is photographed *with* his sequential employment number, which becomes his identification and payroll number, and shows his height and weight and date of hiring.

The new man is then taken to the dispatcher and there the new men are grouped and taken by one of fifteen messengers to the portion of the work for which they have been hired. When the messenger delivers a new employee to a department, the requisition issued the day previous is canceled, and the foreman signs a receipt discharging the obligation of the Employment Department.

The messenger is made necessary for several reasons, but principally because the plant covers 900 acres, has 18 miles of streets and is 2½ miles long and a mile wide, and it is quite a task for a newcomer to find his way about.

Hog Island has all the problems of sanitation and hygiene of any city of 35,000. The mosquito has been absolutely eradicated, and with it vermin of all kinds. The department maintains a chemical and bacteriological laboratory, which tests the drinking water supply at all points

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of egress daily, analyzes sewerage, samples and tests all food served, and does all the work of the hospital on sputum, pus, excretions, blood, urine, etc. It also maintains the medical dispensary, contagious hospital and detention barracks, and its alertness and efficiency have made possible the phenomenal record of last winter as to the general health of workers, resident on the island, and the record of the present influenza epidemic. For both, Hog Island records were as good as any shown by army cantonments.

The housing department task has been trying, but barracks have been completed on the island for 5,000 employees, a bachelor hotel has just been opened accommodating 2,200 men, with 2,200 rooms. A unit of 953 homes for married employees of Hog Island, which rent for an average monthly rental of $25 for six rooms and bath, is being completed. During the last year the housing department has furnished 16,500 accommodations in the city of Philadelphia.

The wage setting and adjustment for the job has been a serious task, and, while the U. S. Shipping Board Labor Adjustment Board has fixed a standard scale for all shipyards, covering the shipbuilding trades, the construction of Hog Island presented many problems on construction rates involving almost every conceivable craft. Not one day has been lost through strike or labor difficulty. The "open shop" has been maintained throughout, and it is only justice to say here that organized labor has, in the main, lived up to its agreement with the Government in not attempting to force recognition or the "closed" shop.

Almost the universal problem with employers has been the question of securing a sufficient number of employees to operate at maximum capacity. It has been a question of "collection," not of "selection."

Non-Financial Incentives

As we begin to deal more and more with large organizations like Hog Island, and as operations become more highly specialized daily, the new theories of dilution of labor and standardization of parts tend to make these operations more stereotyped. How can we still retain the old feeling of craftsmanship is the question which Robert B. Wolf endeavors to answer in his paper on non-financial incentives. By the rivet records kept in the shipyards, this scheme has been attempted; the experiment, however, tended toward the development of expert technique by a few rather than complete understanding of all the features involved in the operation by the many.

Mr. Wolf believes that creative work can be done to a great extent in modern industry without radical changes in equipment. To do this, individual progress records are necessary, so that the workman can know from day to day how he is improving in the mastery of the process.

Although the example taken from the wood pulp industry, with which the author is connected, has no direct application in many trades, the principles involved might be applicable elsewhere.

The example, illustrated by Fig. 1, is from that branch of the wood pulp industry known as the sulphite process and shows a cooking chart which was designed to give the cook information about the reactions in the digesters in which the wood chips are cooked in a 6 percent solution of sulphurous acid partly combined with a lime base. The skill in cooking consists in the proper control of the relief valve.

At the end of the cooking process the gage and steam pressures will naturally come very close together, as the greater part of the SO_2 gas has been used. The gas-pressure curve is obtained by subtracting the steam pressure from the gage pressure. It is really a resultant of the other two. If it drops too rapidly the cook knows he is relieving his digester too hard and checks the opening of the relief valve. If it does not drop rapidly enough he knows he must open the valve wider in order to increase the relief. Naturally, an ideal cooking chart was soon formed, being the joint work of the cooks handling the digesters and of the chemical research department.

Immediately after the introduction of these charts a very marked increase in the uniformity of the pulp was noticed, and the cooks, while at first opposed to the new method of "cooking with a lead pencil," as they called it, soon learned to like their work much better, for the reason that they now had some way of visualizing the work in its entirety. In addition to more uniform quality of the pulp,

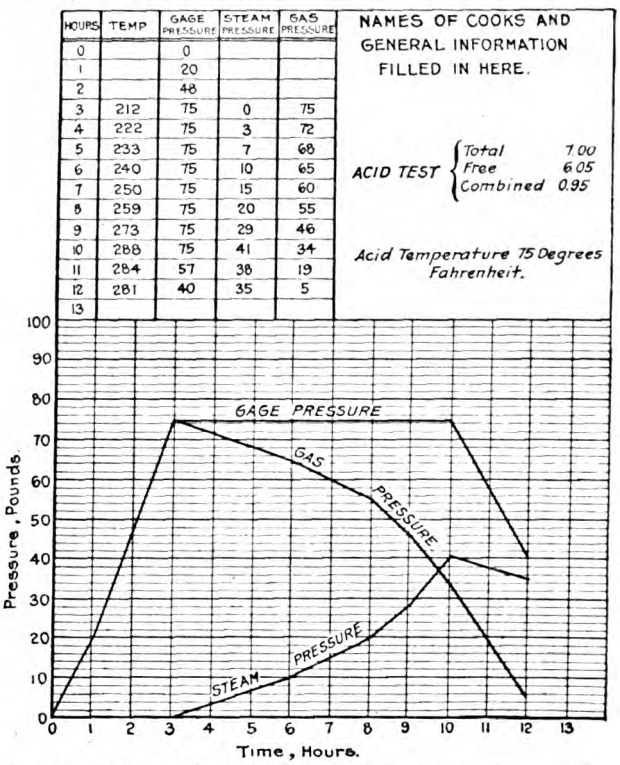

Fig. 1.—Cooking Chart for Wood Pulp Showing Steam and Gage Pressures and Gas Pressure Computed from Them

the yield from a cord of wood increased something over 5 per cent. It was found necessary to establish a continuous progress record to stimulate constant effort.

Such records can be grouped under three main headings: Quantity records, quality records and economy or cost records. Records of the costs will be a natural growth of the interest developed, as will intelligent study of new equipment.

We should never lose sight of the fact that the degree of conscious self-expression which the workman can attain is in direct proportion to the ability of the organization to measure, for his benefit, the impress of his personality upon it.

"In conclusion," said Mr. Wolf, "I am well aware that to some of you this may seem like pure philosophical speculation far removed from the practical affairs of everyday life. I have said nothing, however, that I cannot back up by any number of additional illustrations, and my hope is that the example given will stimulate others to make similar investigations, so that we can fulfill our mission in this country by evolving an industrial philosophy which will have for its ultimate aim the continuous unfoldment of the latent powers in man."

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliares—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Two Handy Tools for Repair Work

The two handy tools illustrated have been found to be time and money savers in the installation or repair of power plant machinery.

In Fig. 1 is shown a ratchet drill holder. This sketch shows plainly just how the holder is made; also the advantage over the old-style holder or, as it is generally termed, the "old man." For drilling pipes or shafting especially this holder will prove a time saver.

The two elevator rods consist of 7/8-inch by 24-inch or 36-inch round C. R. M. steel, bent as shown for an 8-inch

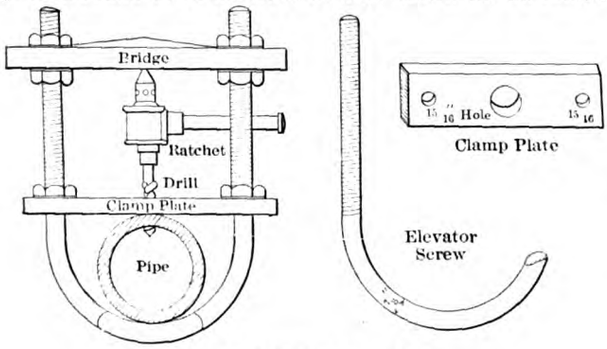

Fig. 1.—Ratchet Drill Holder

or 12-inch radius and threaded for a length of 14 inches. The clamp iron and bridge are 12 inches by 2 inches by 5/8 inch, respectively. Drilled with a 15/16-inch drill on each end to slide over elevating rods, the clamp iron has an opening in the center for the drill guide, as shown in sketch.

In Fig. 2 is shown a shaft and pump piston rod straightener. This tool will come in handy for many pump, shaft, or piston rod repair jobs and should be employed in any shop doing engine repair work and on board ship.

The construction of this tool is very simple and can easily be made in any blacksmith shop; that is, the part marked *B*, the dimensions of which are given. The arm or lever plate has a length of 12 inches, 18 inches, 24 inches, or longer, according to requirements. The fulcrum or shaft-bending screw is of heavy construction, made of carbon steel and hardened on the point, having a full length of V thread, five threads per inch. A "bending indicator" is attached to *B*, thus eliminating all guesswork when bending shafts.

When there is no lathe at hand for doing this work, a work bench or the floor may be used as a base for revolving the shaft or rod by using two 3/4-inch by 10-inch bolts, cutting off the heads, bending the bolts to an L, then cutting a 60-degree bevel on the end and driving the bolts in the bench or floor.

Stillwater, Minn. ANDREW DORTHEN.

A Feed Water Improvement

Some time ago there occurred in the columns of MARINE ENGINEERING a general discussion concerning the best position on the boiler for the feed check valve. Judging from the troublesome experiences of my sea-going brothers, as well as my own, this problem of feed water heating is, in my opinion, entitled to far more consideration at the hands of superintendent engineers than it generally receives.

In this particular case the feed water caused so much trouble that our chief resolved to make some improvements. This we were all glad to hear, for the saving in coal and labor, not to mention the improved circulation of the water, more than compensated for the additional expense.

I can safely recommend the idea evolved from the following repair to all my brother engineers, since our superintendent was so well pleased with the results obtained that several other vessels of the company's fleet were so fitted.

The old check valve with its internal feed pipe, which projected into the interior of the boiler for about 3 feet, was taken off and a new check valve fitted on, but, instead of the internal pipe having slots on the under side to allow the feed gaining access to the boiler, it was screwed at the end (gas thread) so as to engage a coupling. A straight length pipe, about 4 feet long, threaded at both ends, was then screwed into the coupling at one end, and at the other end an elbow branch was screwed on; then another straight length of pipe, threaded at both ends, was fitted, one end being screwed into the above-mentioned elbow branch. This last length of piping measured the length of the boiler.

A second elbow branch was then screwed to this straight length of pipe, and a straight length of pipe, about 2 feet long, was coupled onto the last elbow branch. While the other end was screwed into an elbow piece, a length of

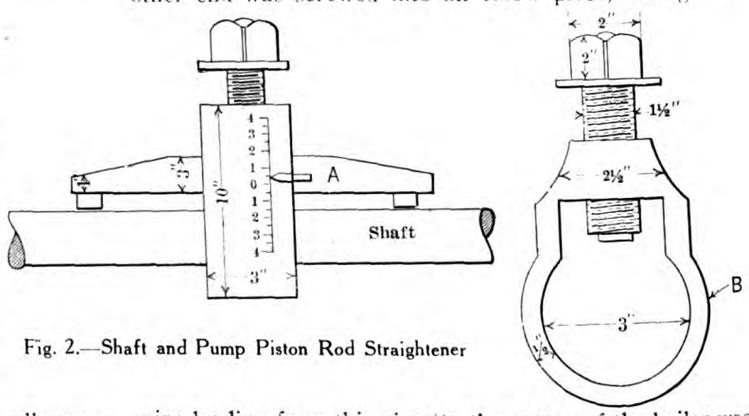

Fig. 2.—Shaft and Pump Piston Rod Straightener

pipe leading from this piece to the center of the boiler was next laid down, and to this length a T piece was coupled, which allowed the feed water to gain admittance to the boiler. This T piece was made 3 feet 6 inches long and reached down fully 18 inches, all the pipes and elbow branches being jointed by touches of red lead and screwed well home.

It will be readily understood that all these feed pipes were laid down on the top of the tubes which carry heat

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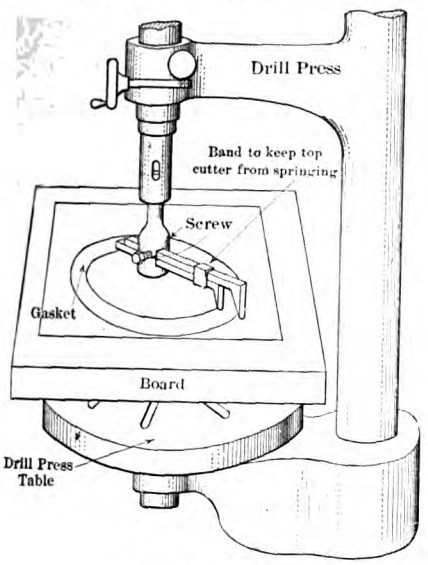
to the water, so that the feed water was practically obtaining heat from the tubes beneath and from the boiler water above.

No doubt many of the readers will wonder why bends were not employed instead of elbow branches. This was done in order to allow for easy inspection of the different straight lengths in case any trouble should occur.

Sydney, N. S. W. ANDREW LANG.

Gasket or Circle Cutter

A very handy gasket or circle cutter for use in the spindle of the drill press is made by machining a piece of 2-inch round stock to a standard Morse taper to fit the



Gasket or Circle Cutter

drill press, drilling and filing a slot for the cutter bars and fitting two securing cap screws. The cutter bars are each adjustable to various diameters. The sketch tells the story. C. H. WILLEY.

A Steam Pipe Repair Job

While in port the chief engineer decided to have a few necessary repairs made to the engines and boilers. Accordingly, orders were given to blow down all boilers, and, having raised steam on the donkey boiler, the second engineer went up on top to open the auxiliary stop valve. Immediately on opening it, however, he was surprised to hear a hissing sound. Upon investigation, a piece of pipe, as

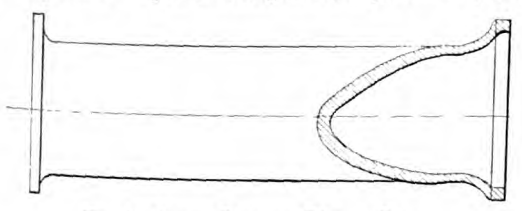


Fig. 1.—Steam Pipe as Blown Out

shown in Fig. 1, was found to be blown out. This, of course, made it necessary to close down again and generate steam in one of the main boilers.

The chief, in the meantime, went ashore to see what he could pick up in the way of piping. His search resulted in a piece just 30 inches too short, so it was decided to make the following repair:

By referring to Fig. 1, it will be seen that the blow-out occurred in such a manner that the pipe had the appearance of having been cut by a knife, the break being almost at an angle of 45 degrees. This, however, enabled us to make a good repair job.

By removing the lengths of pipe connected to the fractured piece, we were able to drill two 1 1/16-inch holes through the broken pipe and two holes of the same size through the bottom part of the steam pipe. We then made two 1-inch studs with nuts and washers, also two pairs of clips, or brackets, Fig. 2.

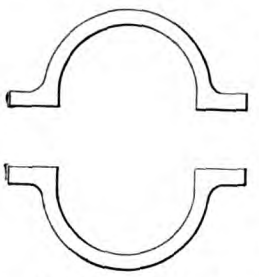


Fig. 2.—Improvised Brackets

The broken part of the pipe contained two bolt holes; but we did not think it wise to place bolts through, so the holes were drilled and tapped for 7/8-inch studs, since it was evident that on being tightened the studs would not draw the fracture apart, as would be the case if bolts were used.

Everything being now prepared, a large quantity of Smooth-On, previously made up, was applied to the fractured pipe, and, carefully putting on the broken part, so as not to disturb the Smooth-On, we had it properly bolted

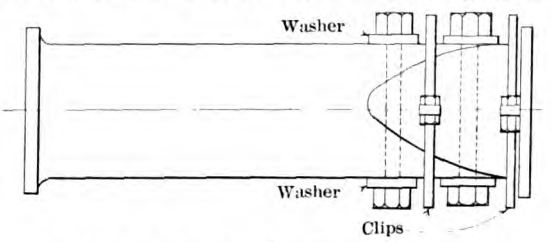


Fig. 3.—Pipe Showing How Repair Was Effected

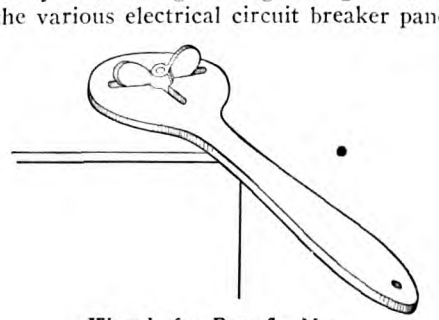
down with the studs and washers with a lappet or gromet thoroughly steeped in Smooth-On. After adjusting the studs we then put on the clips, one between the flange and die stud and the other between the two studs. The remaining length of pipe was then bolted on and the job was completed. Steam was again raised in the donkey boiler, and, heating up slowly, we put a little more strain on the studs, clips and joint. After lagging the pipe over again, the stop valve was fully opened and we were delighted to see that our efforts were successful.

Fig. 3 shows how the repair was effected.

MECHANIC.

Butterfly Wrench

For readily unscrewing and tightening of the butterfly nuts of the various electrical circuit breaker panel doors,



Wrench for Butterfly Nuts

junction boxes, and other casing covers about the ship, one of our electricians has made a very useful little plate iron butterfly nut wrench, a clear sketch of which is shown in the illustration. It may be of the same value to others, so it is passed along. C. H. W.

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Some Interesting Repairs

The following may be of interest to some of the "sea-going" readers:

Fig. 1 represents the high pressure column and part of the condenser of a triple-expansion engine, column and condenser being cast in one. While under way, water commenced to run down the high pressure guide, and after a short while a piece of the guide, about 8 inches by 10 inches, fell out of the column at *A*. Even with the engine

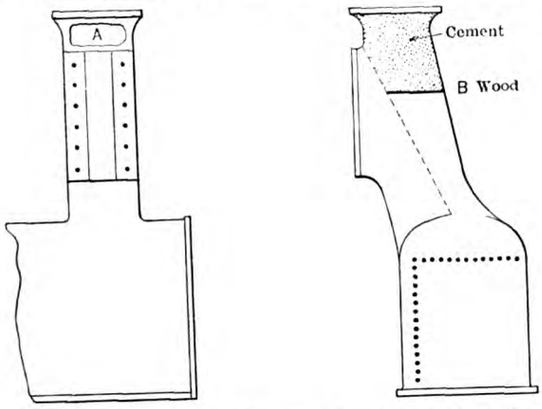

Fig. 1.—Showing High-Pressure Column and Part of Condenser of Triple-Expansion Engine

stopped the water continued running, and for a time we were at a loss to understand the cause.

On shutting the main injection, the flow stopped, and after opening the condenser door we found that the column was divided so as to form an air vessel for the circulating water. A wrought iron patch, fitted temporarily over the hole and secured by ⅝-inch brass tap bolts and a rubber gasket, took us into port; but, as the metal was spongy and did not give a good hold for the screws, these were removed later and a piece of wood fitted at *B*. The column above the wood was then filled solid with Portland cement, thus making a permanent repair.

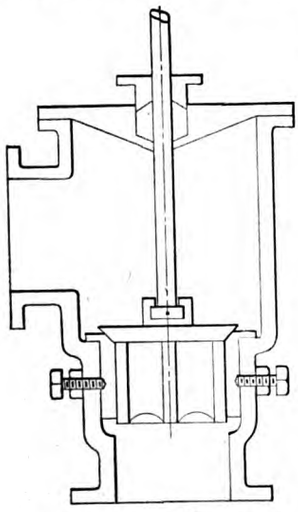

Fig. 2.—Showing Stop Valve on the Same Engine

Fig. 2 shows the stop valve (8 inches diameter) on the same engine. While giving the engines a try-out, the seat lifted, entirely shutting off the steam. As the valve was only partly open, we were able to get the seat back by closing the valve tightly. This was repaired by drilling and tapping four ¾-inch holes, just allowing the point of the drill to enter the brass seat. Tight-fitting tap bolts were screwed home and lock nuts set up, after which the seat gave no trouble.

Fig. 3 shows a diagram of the working parts of a steam reversing gear (engine 1,200 indicated horsepower). This gear had given trouble for years; the steam cylinder received steam at 160 pounds per square inch, but, in addition, one and sometimes two men were required to help pull around the wheel. In port, with no steam available, the gear could be operated easily by the handwheel, but on applying the steam the gear locked itself. After some discussion we finally came to the conclusion that the fault lay in the screw on the shaft. As this had a rather fine pitch, the force of steam, acting almost at right angles to the thread, produced a locking action. The shaft was therefore cut and a new end fitted having a thread of double the pitch and new nut to suit.

After this the gear gave no further trouble; in fact, it was as handy as an all-round gear and quicker in action, although, of course, somewhat harder to move when tried by hand alone.

San Francisco. A. B. BLUNDUN.

Some Defects in Marine Design

The need for improvement in the design and layout of engine and boiler rooms, especially in auxiliary plants—pumps, fans and electric lighting—is evident to the most casual observer. Those who work in the engine room, however, also realize certain defects in the design of boiler mountings, such as check valves, stop valves, safety valves and steam pipes. It is against these that I wish to vent my sentiments.

Now take, for instance, the check valve, which, in my estimation, is one of the most important valves on a

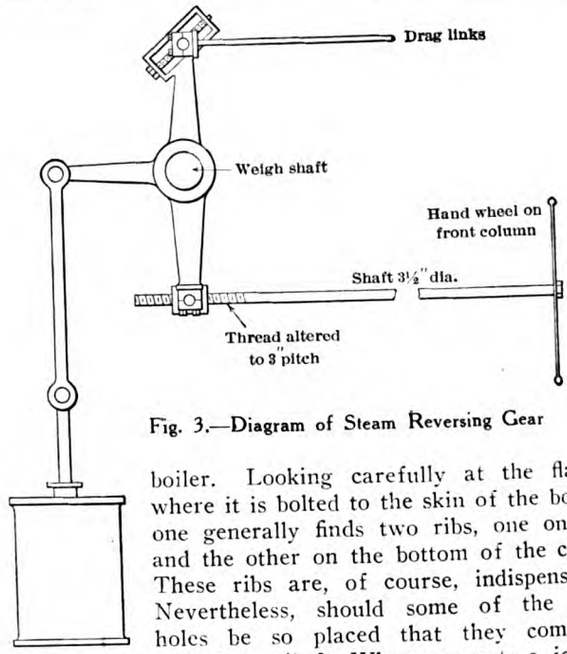

Fig. 3.—Diagram of Steam Reversing Gear

boiler. Looking carefully at the flange where it is bolted to the skin of the boiler, one generally finds two ribs, one on top and the other on the bottom of the chest. These ribs are, of course, indispensable. Nevertheless, should some of the stud holes be so placed that they come in close contact with these ribs? When one gets a job of taking off a check valve and putting it on again one is apt to wish the draftsman who designed the job the compliments of the season, as I have done many a time. I refer principally to tightening up those nuts which foul the ribs. Since in these positions it is impossible to grip a full nut with the spanner, one generally has to use a calking tool to tighten up these nuts. You can never judge whether the nuts are hard up by this method, and as a result the nuts are chewed away. That makes it always harder for one when the valve has to come off again.

But this is not the only disadvantage. By using a calking tool, the studs are very liable to be broken off, which generally means taking off the valve and starting all over again. In the case of other nuts the holes in the casting are generally marked off and drilled so close to the body of the casting that when the nuts are being tightened down the corners of the nuts generally foul the body of the casting. This results in one's having to take two bites at the nuts instead of one.

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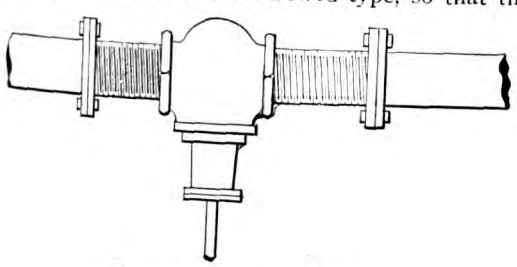
In the case of the stop valves, the bridge is often cast onto the cover. One generally finds four nuts, two on each side of the bridge, hard up against the bridge. The position of the stop valve on the boiler, of course, brings it more directly under the control of the engineer. Not so with the check valve. One generally finds trouble in gaining access to this, because the smokebox is hard up against it. This inconvenience makes the nuts which are close to the ribs still harder to tighten up.

But one of the most badly designed jobs I have ever seen or handled was in a stokehold containing six boilers, where an auxiliary steam pipe was laid down, and also a line of main steam piping. Both lines of piping commenced on the forward center boiler and ran parallel across the top of the center after boiler to the engine room. On the top of this boiler was a main stop valve, and just where the main steam pipe passed this stop valve there was an expansion joint with six 1⅛-inch nuts on the gland. The distance from the expansion stud to the stop valve was only 3 inches, with the same distance between the auxiliary steam pipe and the other expansion stud. The spanner could only be used on the two top nuts. To slacken or tighten up the other four nuts one had to employ the services of a light flogging hammer and a chisel bar, which generally resulted in knocking the nuts totally out of shape and making them useless. Every time this expansion joint had to be packed it meant new nuts; and yet marine engineers are constantly being told to economize! I had the pleasure of packing this particular joint twice, with the temperature well up over 90 degrees—the hardest job experienced during my sea time. In my estimation, it would have been far better to have designed this gland to carry four 1¼-inch nuts instead of six 1⅛-inch nuts. An expansion bend would have obviated the trouble and saved time, money and unsuitable language.

A. L.

Facilitating Removal of Regulating Valve

On the supply or make-up water lines to our feed tanks we had a number of balanced float-controlled regulating valves, and because of the wire drawing of the water it was found necessary to remove them and grind them in at frequent intervals. These were 2-inch lines, and the regulating valves were of the screwed type, so that their



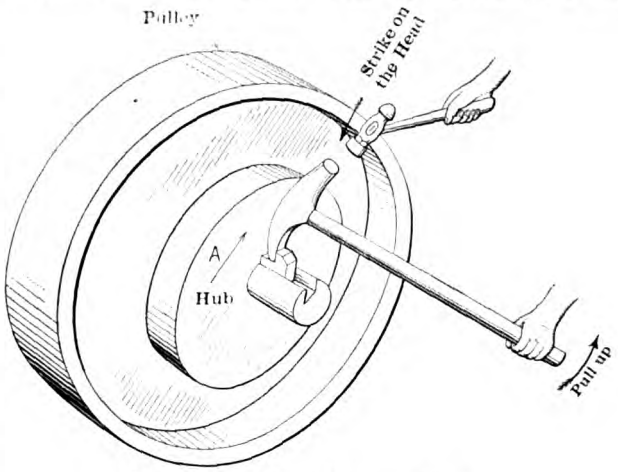
Removable Regulating Valve

removal involved the taking down of part of the make-up piping each time.

We finally overcame this difficulty in the manner shown in the sketch. Two long nipples were screwed in the inlet and outlet of the valve, and then to the end of each nipple was screwed a companion flange which matched a similar flange screwed onto the ends of the water piping. The distance between the flange faces was made a standard dimension—10 inches. Hence when it was necessary to regrind a valve it could be quickly removed from the line by simply removing the holding bolts from the flanges and slipping out the section containing the valve. An extra valve, made up with the nipples and flanges, was always kept on hand, which could be slipped into the space and the whole controlling mechanism put back in operation in less than ten minutes' time. The worn valve could then be ground in at leisure and held in reserve. W. A. L.

Key Jimmy

This tool is about the handiest and most efficient simple tool that the writer has ever met with, and because it is so constructed like a jimmy it has been given that name.



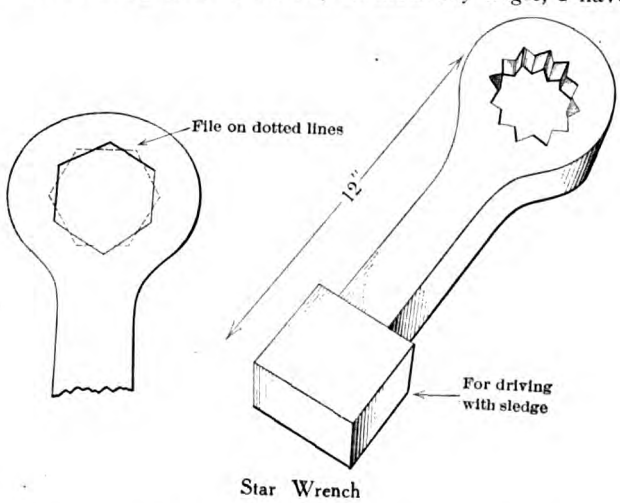
Key Puller Which Does the Work

Its effectiveness lies in the combination of leverage, plus jarring forcing blows, as illustrated. The upward pull of the lever is maintained while striking the blows as the key moves out. Packing pieces are used behind the heel of the tool at *A*.

ENGINEER.

Star Wrench

While the writer is not the originator of this type of wrench, he has used several of them on board ship for adjusting main bearing nuts, and, as they permit the wrench being used so handily at most any angle, I have often wondered why all ships' engine rooms do not have them.



Star Wrench

I have visited many ships and have noted that the old type hexagon box wrench is about the only thing they have, so I am submitting these sketches showing how the old wrenches can be made over into this handy star type.

OLD TIMER.

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

CONDUCTED BY "NAVAL ARCHITECT"

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Development of Hawse Pipe

Q. (991).—Will you kindly explain how to lay out and develop hawse pipes for stockless anchors, also how to obtain a true section through the centerline of same with respect to pipes and shell of ship?

A. (991).—This question would require a rather lengthy answer, and it does not seem well at this time to publish the same in these columns. One method of making this development is given in "Laying Off," by Attwood and Cooper, published by Longmans, Green Company, New York.

"Push" and "Pull" on Crank Pin

Q. (994).—Find push and pull on a crank pin, 72-inch cylinder, 10 pounds pressure, 26-inch vacuum. Should the text not read "push" *or* "pull"? What would you give as the definition of "push" and of "pull"?

A. (994).—This question was answered in the July, 1918, issue. It is probably expected that the answer gives the steam force acting upon the piston rod at the beginning of the down stroke and up stroke, or a "push" in one case and a "pull" in the other.

Duties of Loftsman, Shipwright and Shipfitter

Q. (990).—Please define the duties of a loftsman, shipwright and shipfitter. X.

A. (990).—Loftsman is the term given to men who, working indoors, prepare in the mold loft templates of the various parts of a vessel's hull. It is customary in this country for the loftsman to take the offsets from the draftsmen's small scale lines, lay them down and fair them full size on the loft floor. From blue prints he may then proceed to make molds of the frames, floor plates, deck beams and practically all parts of the vessel—in many cases all but several of the shell plates. The templates are usually made of wood or heavy paper.

To the shipwright or ship carpenter is given the work of laying the keel blocking, putting necessary staging in place, shoring the structure and fairing the frames with ribbands. Placing the launching ways, laying planking, tank-top ceiling and all outside carpentry work would generally be done by the shipwright. The fact that a loftsman often used wood in the construction of the molds made it natural for the shipwright to take up loft work. Mocking up intricate portions of the structure does in reality require no small skill.

Formerly a shipfitter was expected to make all molds, using blue prints then issued and constructing molds of the work as these were necessary. Now the shipfitter lays off the plates and shapes from the molds sent from the loft, directs the assembling of the structure and lays off holes not located in the loft. He may be given the work of making molds in case of alteration of difficult plates, which is termed "lifting."

The truth of the matter is that all three of these trades are similar; in fact, in large shipyards each of them in turn is often divided into several special ones.

Point of Cut-Off

Q. (993).—An engine has 3 feet 6 inches stroke, ⅛-inch lead and 2½-inch lap; the valve travel is 10 inches. What is the point of cut-off? I would appreciate having the answer in the form of a formula and also by a graphical method.

A. (993).—Fig. 1 shows the solution of the problem by Zeuner's diagram. With O as center and OG radius, equal to one-half the valve travel, draw circle ECG. Lay off OA

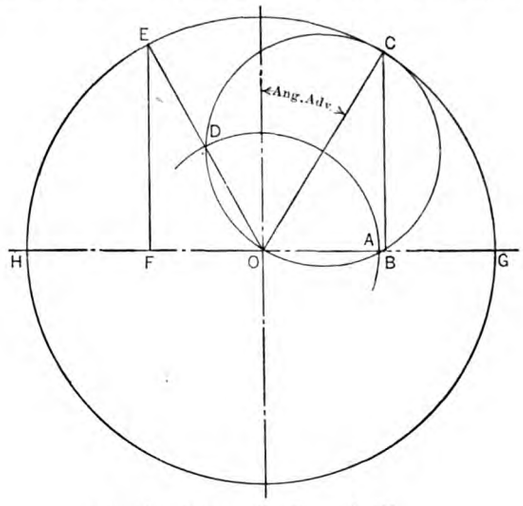

Fig. 1.—Solution by Zenner's Diagram

equal to the lap and AB equal to the lead, and erect BC perpendicular to OG. The line OC will now be the diameter of the circle BCD, which in turn will give the location of the valve from its mid position. Hence the cut-off will occur when the valve displacement is equal to the steam lap, or at the crank angle ODE. If the effect of the connecting rod is neglected, cut-off will occur at $\frac{GF}{GH}$, or about .74 of the stroke. Although possibly there are some arbitrary rules which will give the position of the cut-off, I do not know of these. If desired, the point of cut-off may be found by this formula, which requires a knowledge of trigonometry for its application:

$$\tfrac{1}{2}\sin\left[\cos^{-1}\left(\frac{\text{lap}}{\tfrac{1}{2}\text{ travel}}\right)-\sin^{-1}\left(\frac{\text{lap}+\text{lead}}{\tfrac{1}{2}\text{ travel}}\right)\right]+.5$$

This formula, likewise, does not take into account the angularity of the connecting rod.

Effect of Linking Up High-Pressure Cylinder

Q. (992).—Suppose you have an engine whose cylinders are developing the same power and you run the cut-off in on the high pressure, which cylinder does the most work?

A. (992).—Running the cut-off in on high pressure will reduce the total work of the engine; it should not change the division of work among the cylinders.

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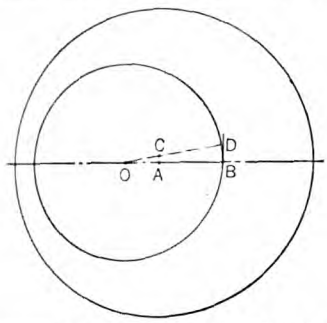
Valve Movement by Shifting Eccentric

Q. (995).—If you move an eccentric having a 5-inch throw, ⅛ inch on the shaft, diameter 15 inches, how much do you move the valve? How would you measure the ⅛ inch on the shaft? The answer is ⅛ × 5/15 = 1/24 inch. How would you reason this out?

A. (995).—For small changes of angular advance (shift of eccentric) the change in position of valve may be readily found in the manner outlined here.

O is the center of shaft, A the center of eccentric. Then if the eccentric is moved around the shaft so that B takes the position D, then A, the center of the eccentric,



will move a proportionate distance and will be at C, or

$$\frac{AC}{BD} = \frac{\text{½ travel of valve}}{\text{½ diameter of shaft}}; \text{ i.e., } AC = \tfrac{1}{8} \times \frac{2\tfrac{1}{2}}{7\tfrac{1}{2}} = 1/24 \text{ inch.}$$

It should be noted here that the throw of the eccentric, as used in this case, means the total travel of valve.

Women as Naval Architects

The entrance of women into many scientific activities has shown itself from time to time in an earnest desire to be given a status in the particular activity in which they have qualified themselves to become useful members. It is certainly a sign of the times when the council of the Institution of Naval Architects is seeking to obtain the views of the various classes of members of the institution on the subject of the admission of women to the class or classes of membership for which they may, apart from the question of sex, be qualified under the present rules of the institution. At the present time women are not eligible under the existing rules covering the admission of candidates. To make their admission possible, therefore, it will be necessary to alter such rules, which procedure requires the assent of a two-thirds majority. If this is obtained, the consent of the Privy Council to the corresponding alteration in the Royal Charter of Incorporation would also have to be obtained. It is understood that at the present moment there are only three women seeking admission into the institution. Each of these applicants has received a technical training and has been engaged in making calculations or carrying out experimental work connected with shipbuilding. One of these applicants is the joint author with a member of the institution of a paper contributed to last year's transactions. This paper, "The Effect of the Longitudinal Motion of a Ship on Its Statical Transverse Stability," by Mr. G. S. Baker, O.B.E., and Miss E. M. Keary, was read recently. If women are admitted, they will only be admitted on the same qualifications which apply to men.

Shipping Developments at Belfast

Definite and interesting information as to the shipbuilding developments now under way at Belfast was communicated by the chairman of the Belfast Harbor Board at one of its recent meetings. During the past year about 150 acres of the harbor estate on both sides of the River Lagan have been let to the local shipbuilding firms, almost doubling the area previously devoted to shipbuilding and marine engineering. About 124 acres have been let to Messrs. Harland & Wolff, Ltd., and 24 acres to Messrs. Workman, Clark & Company, Ltd. On an area of 85 acres of recently reclaimed land on the east side of the Musgrave Channel, Messrs. Harland & Wolff's contractors are now laying out a new shipyard, erecting workshops and installing the necessary overhead equipment. With a water frontage of over 900 feet, there is accommodation for six building berths. On these it will be possible to construct vessels up to and over 1,000 feet. On another area of 40 acres, situated between Musgrave Channel and Queen's Road, the same firm intends to lay down premises for engineering purposes.

Messrs. Workman, Clark & Company have also acquired 24 acres for extensions to their north shipbuilding yard, supplementing the extension carried out about five years ago, at which time the firm laid down two building berths. At present the firm has twelve building berths, five of which are in the south yard. Side by side with this private enterprise the harbor commissioners are embarking on a most extensive scheme of harbor works, including wharves and jetty quays and deepening of channels. The operations incident upon the carrying out of these changes will be spread over a considerable number of years. Parliamentary powers, involving an expenditure of two and one-half million pounds on these works, including the construction of a new graving dock 975 feet long, with an entrance width of 111 feet, have been obtained during the present session.

NEW BOOKS

STORING, ITS ECONOMIC ASPECTS AND PROPER METHODS. By H. B. Twyford. Size, 6 by 9 inches. Pages, 200. Illustrations, 96. New York, 1918: D. Van Nostrand Company. Price, $3.50.

This book, which has been compiled by a man who in his connection with the Otis Elevator Company has had unlimited opportunity to collect valuable data, gives clear specific suggestions for the solution of storing problems. The subjects covered include: Economic Questions Connected with Storing; Specifications, Definitions, and Standardization; Location and Equipment of Storeroom; Appliances for use in the Storeroom; Manual Operations; Clerical Work—Inventories; The Stores Department; Receiving Material; Inspecting and Placing Material in Storeroom; and Deliveries from Storeroom.

THE SHIPBUILDING INDUSTRY. By Roy Willmarth Kelly and Frederick J. Allen, director and assistant director, Harvard Bureau of Vocational Guidance. Introduction by Charles M. Schwab. Size, 5½ by 8 inches. Pages, 302. Illustrations, 103. New York, 1918: Houghton Mifflin Company. Price, $3.00.

Written with the assistance of the Shipping Board and prefaced by Charles M. Schwab, this book may be considered authoritative in all its details. The illustrations include pictures of shipyards and shipyard work over the entire country, covering the chief operations in present-day ship construction. The following headings serve to indicate the scope of the book: A Great National Enterprise, Reviving a Neglected Industry, Products of the Shipyards, From the Blueprint to the Finished Ship, A Glimpse of a Modern Steel Shipyard, Naval Architecture, The Construction of the Hull, The Metal Trades and the Electrical Department, The Woodworking Shops and Yard Maintenance, Executive and Clerical Positions in Shipbuilding, The Building of Wooden Ships, Recruiting and Training the Industrial Army, Future Employment Opportunities in American Shipbuilding.

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Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

REQUISTIONED SHIPS BEING RELEASED TO OWNERS

Shipping Board's Decision Affects 248 Vessels Aggregating 1,219,000 Tons

Early in January announcement was made by the Shipping Board of the release of requistioned vessels of 3,000 tons or under from Government control. On January 16 all requistioned vessels, except a few retained for transport service, were ordered to be turned back to their owners. The vessels will be actually released as soon as present voyages have been completed and ships have been docked at American ports. In every case release will be given on each individual vessel, and not as a class or group of vessels. No conditions are placed upon the owners, except that they are obliged to maintain ocean freight rates wherever fixed and announced by the Board.

According to estimates of Shipping Board officials, 248 vessels aggregating 1,219,000 deadweight tons are affected by the Board's decision. In the place of those ships which are retained for transport service, because especially fitted for that purpose, owners will receive an equal tonnage of Government-owned and equipped ships.

With the withdrawal of the American-owned requistioned shipping from the Shipping Board's jurisdiction, those vessels remaining under the Board's control are the few requistioned ships used for transport service as noted above, vessels requistioned on the ways when only partially complete, but title to which was obtained by Government purchase, vessels constructed out of Government funds, and the chartered and commandeered foreign tonnage. The total number of ships owned by the Board is 636, of 2,348,250 gross tons; of which 534, of 1,994,913 tons, are new vessels; 59, of 257,962 tons, are former German ships; 6, of 24,417 tons, former Austrian ships, while 37, of 100,962 tons, are former Great Lakes ships.

Neutral Ships Released

On January 8 the Shipping Board announced that neutral vessels would be permitted to charter to the various time charters as in pre-war times. It is understood that 80 steamships of 478,769 tons requistioned from Dutch owners for the war emergency will also be returned to their owners at an early date, with the same proviso that in cases where former Dutch ships are now in service as transports they will be replaced ton for ton by Shipping Board-owned vessels. The Board also has under requisition approximately 300 steamers of about 1,417,000 tons owned by other foreign Governments than Holland, which will come under this ruling.

British Government Releases Requistioned Ships on March 1

On January 15 the Shipping Controller announced that British ships completing voyages on and after March 1 at ports of delivery in the United Kingdom, or, in exceptional cases, at ports abroad, will be relieved from requisition, except in so far as they are required for Government purposes, or if they are ships to which special conditions apply. With a view to safeguarding the essential imports and exports of the United Kingdom and the Allies, it is explained, it will be necessary for some time to maintain a system of direction as to the employment and limitation of freight rates for essential commodities. The release does not apply to ships wholly engaged in the naval and military services.

French Requistioned Steamers Will Be Returned

Under date of January 12 the French Government announced that all mail steamers requistioned by the Government during the war would be placed at the disposal of their owners before February 15.

SHIPPING VALUES TO BE WRITTEN OFF

Hurley Plans to Cut Off $1,000,000,000 of Total

After extensive investigation, Chairman Hurley, of the United States Shipping Board, has formulated a policy, which has been officially approved, to write off virtually $1,000,000,000 from the cost of American shipping built during the war. A proportionate write-off from the valuation of American shipyards may possibly be included in the finished plan. This write off, which would apply to ships worth approximately $3,000,000,000, would enable American shipping to make rates that would insure successful competition with other maritime nations and keep the seas open to the great business developments expected at the end of the war.

Colby Resigns from the Shipping Board

Announcement has been made of the resignation of Commissioner Bainbridge Colby from the Shipping Board. This resignation, which has been on file since last December, has only recently been made public. Although Mr. Colby felt the necessity of returning to his private business as soon as possible, he has remained with the Shipping Board during the interim, knowing that his services were still necessary. His work as Commissioner has at all times been greatly appreciated by Chairman Hurley and the other members of the Shipping Board.

FIRST SHIPPING BOARD VESSELS ALLOCATED

272,584 Deadweight Tons Already Placed

The Shipping Board released thirty-three vessels for private operation on January 16 to establish important services between New York-Greece, New York-United Kingdom, Philadelphia-United Kingdom, New York-Portugal, New York-North Africa and Egypt, New York-Finland, New York-West Africa, New York-South Africa, New York-Dutch East Indies, New York-Australia and New Zealand, New York-Philippines, China and Japan, New York-India, New York-Bahia, Blanca, Port Madry and Punta Arenas, and New York-Antwerp.

These vessels, aggregating 272,584 deadweight tons, were distributed among thirteen companies. The allocation of this tonnage (which is understood to cover all tonnage available for export purposes at this time) will afford considerable relief to exporters.

Committee to Formulate Peace Policy of the Emergency Fleet Corporation

Before his resignation, Commissioner Bainbridge Colby announced the following men as composing the personnel of the committee which has been formed to examine the building plans of the Emergency Fleet Corporation and formulate a peace policy:

J. A. Farrell, president of the United States Steel Corporation; P. A. B. Franklin, president of the International Mercantile Marine Company; George S. Dearborn, president of the American-Hawaiian Steamship Company; H. H. Raymond, president and general manager of the Mallory Steamship Company, and F. D. M. Strachan, president of the Strachan Shipping Corporation. In addition to the foregoing, Charles Piez, director general of the Emergency Fleet Corporation, and John Rosseter, director of operations of the United States Shipping Board, will be ex-officio members. George S. Dearborn and H. H. Raymond serve as the nominees of the American Steamship Association.

France Would Build 2,000,000 Ship Tons in American Yards

The governing committee of the French Naval League, in which are represented shipowners' and seamen's associations, have asked that opportunity be given French owners to purchase immediately 1,000,000 tons of shipping built in England and 1,000,000 tons of shipping built in the United States, and that American yards be opened to French owners for the immediate construction of 2,000,000 tons of cargo steamers.

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MATERIAL HANDLING MACHINERY MANUFACTURERS ORGANIZE

New Association to Improve Freight Handling Facilities at Marine Terminals

In order to aid the Government and private interests in improving freight handling facilities at marine terminals, twenty-five of the large manufacturing companies which build mechanical freight handling devices, formed an association on January 16 at the Hotel McAlpin, New York, to be known as the Material Handling Machinery Manufacturers' Association. It is expected that the membership of the association will rapidly increase. As formed the association embraces five distinct lines of freight handling equipment: (1) Cranes, hoists and winches; (2) power and gravity conveyors; (3) elevators; (4) trucks, trailers and tractors; (5) bulk freight handling machinery.

Calvin Tompkins, formerly dock commissioner of New York City, was elected president of the association, and James A. Shepard, president of the Shepard Electric Crane & Hoist Company, Montour Falls, New York, vice-president. The other officers elected for the ensuing year were: Treasurer, Lucien C. Brown, Elwell-Parker Electric Company, Cleveland, and temporary secretary, Fred Stadleman, Wellman-Seaver-Morgan Company, New York. The management of the association will be in the hands of a board of governors, numbering eight members, which later will be expanded to twelve. The board of governors is comprised of the following:

C. M. Watson, Watson Elevator Company, New York.

William Clarke, Manning, Maxwell & Moore and Shaw Electric Crane Company, New York.

R. W. Scott, Otis Elevator Company, New York.

F. W. Hall, Sprague Electric Works, New York.

Fred Stadleman, Wellman-Seaver-Morgan Company, New York.

Lucien Brown, Elwell-Parker Electric Company, Cleveland.

James A. Shepard, Shepard Electric Crane & Hoist Company, Montour Falls, N. Y.

John C. Walter, Alvey-Ferguson Company, Cincinnati.

The first meeting of the association on January 15 was taken up with the business of organization, and was followed on the 16th by a luncheon at the Hotel McAlpin, at which Hon. William C. Redfield, Secretary of Commerce, was the guest of honor and principal speaker.

Secretary Redfield emphasized the fact that handling charges at terminals is the biggest expense and also the biggest waste in transportation. He contrasted the highly developed terminal facilities for handling bulk freight on the Great Lakes, which make the Great Lakes steamship the cheapest freight carrier in the world, with the poorly developed and wasteful facilities at our seacoast ports, and asked the new association to co-operate with the Government in bettering these conditions.

Other speakers at the luncheon were Calvin Tompkins, former dock commissioner of New York, and J. W. Frazier, of the engineering staff of the Docks and Harbors Facilities Commission of the Shipping Board. James Shepard, president of the Shepard Electric Crane & Hoist Company, presided at the luncheon.

JAPAN HAS CONTRACTS FOR THIRTY-FOUR AMERICAN SHIPS AT $100,000,000

Shipping Board Lets New Contracts for Ships, Barges and Tugs

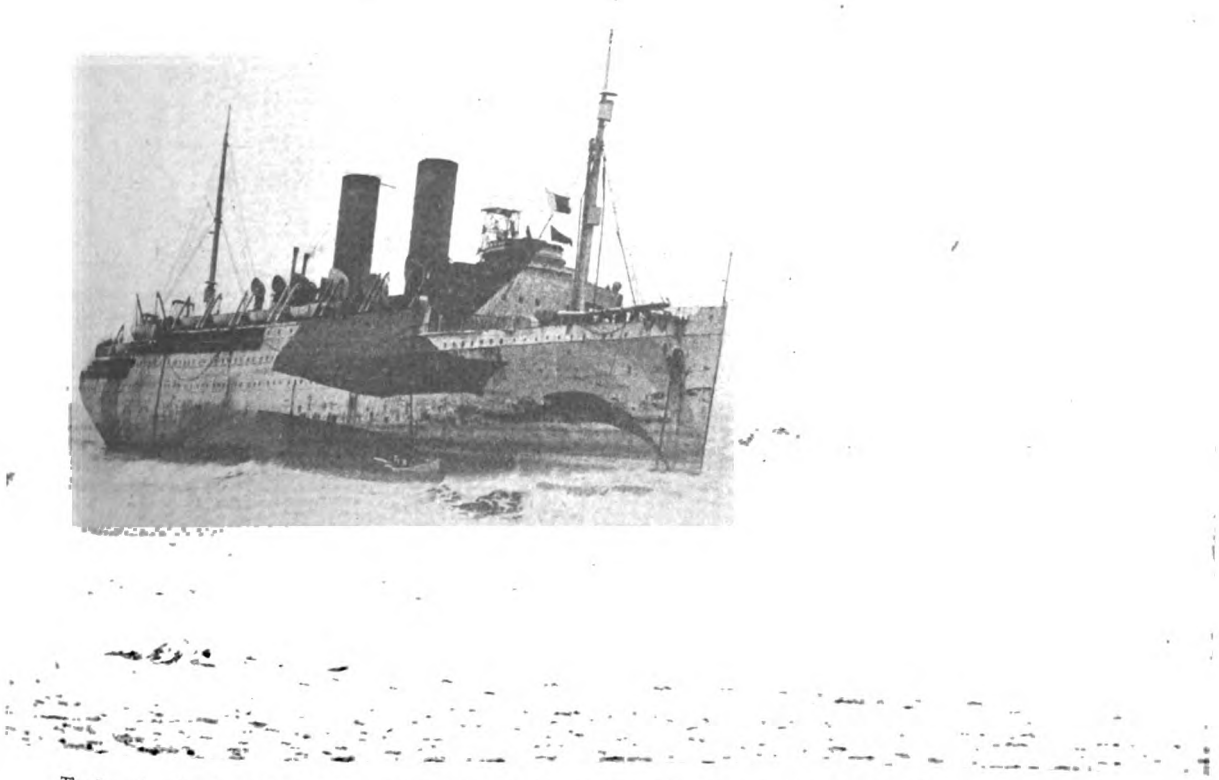
Although contract was let in July, 1918, details have just been made known of the proposition to have Japan build thirty-four cargo ships for the United States Shipping Board at a cost of $100,000,000. Thirty will be built at Kobe and four at Shanghai, China. China has contracted independently to build eight steel cargo vessels at Shanghai to cost $32,000,000.

A special order, signed by Howard Coonley, vice-president of the United States Shipping Board Emergency Fleet Corporation, under date of December 18, 1918, announces the execution of new contracts during the weeks ending October 19, 26, November 2, 9, 16, 23 and 30, 1918. Reports of these contracts have been held up pending determination of the corporation's programme of cancellation.

The new contracts include a number of barges, several cargo ships, ranging from 3,500 to 10,300 deadweight tons, ocean-going and harbor tugs and one schooner of 3,200 deadweight tons. The schooner is to be built by the Long Beach Shipbuilding Company, Long Beach, Cal.

The largest ship included in the new contracts is a 10,300-ton transport to be built by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va.

The contract of the Southern Shipbuilding & Dry Dock Company to build sixteen wooden vessels for the Government, which was canceled after the sign-



The Steamship *Northern Pacific*, Which Was Stranded on a Sand Bar Off Fire Island with 2,247 Troops Aboard

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ing of the armistice, has been reinstated. All these vessels are of the Daugherty type. The vessels will be built at the Orange, Tex., yards, but equipped with machinery at Galveston.

The Macdonald Engineering Company, Chicago, Ill., about which a preliminary report was given in the January issue, has a contract for building concrete fuel oil barges at Aransas Pass, Tex., for the France & Canada Steamship Company, 120 Broadway, New York. It is planned to build ten barges as quickly as possible and to contract for others later. Each barge is to be 270 feet long, and to have a carrying capacity of 12,500 barrels of oil. The France and Canada Steamship Company is planning to spend one million dollars in building these barges, which are to be used in the oil-carrying trade between Aransas Pass and Tampico, Mexico.

The Bullock-Caldwell Shipbuilding Company have two 1,800-ton auxiliary schooners under construction at Pensacola and Milton, Fla., in addition to the 1,800-ton auxiliary schooner at the Coyle shipyard.

The Douloutt & Williams Shipbuilding plant, New Orleans, La., will build seven ships of 9,600 tons burden, in all a contract for $15,000,000. To-day Douloutt & Williams have a large shipbuilding plant, representing an investment of over a million dollars. A settlement has grown up in the swamp, office buildings have been erected, a power house sufficient to operate the entire plant is almost completed, and the shipyard itself is firmly established.

The Texas Steamship Company, Bath, Me., is placing orders for materials for seventeen ships which are to be built at once. A total of thirteen vessels were successfully launched by that company during 1918.

The Norway Pacific Shipbuilding Company, Everett, Wash., has received an order from the Coast Guard Service, Washington, D. C., to build five revenue cutters at a total price of $3,435,000.

Reports intimating that the $6,000,000 contract for steel barges and towboats for the Federally-operated Mississippi and Warrior River barge lines would be suspended have been formally denied by a telegram from the Railroad Administration.

The Cunard Line, Liverpool, England, has ordered contracts for English shipyards to build four sister ships to the *Carmania*.

Ten 12,000-ton passenger vessels will be built by the Robert Dollar Company for service between San Francisco, Hong Kong, Shanghai and Manila in competition with the Toyo Kisen Kaisha and Pacific Mail. Contracts will be placed as soon as prices decline. The estimated cost of the fleet will be $10,000,000.

The Halifax Shipyards, Ltd., Halifax, N. S., have received contracts from the Dominion Government for the construction of ships aggregating 10,500 tons.

The Nova Scotia Steel & Coal Company will construct ships of 5,000 tons for the Dominion Government as soon as the contracts are completed.

The Nippon Yusen Kaisha has issued contracts to the Mitsu Bishi shipbuilding yard for the construction of three cargo ships of 10,000 tons deadweight. It is expected that these vessels will be ready for ocean service by the summer of 1919.

Freight Rates Obtainable from Shipping Board

The Division of Operations of the United States Shipping Board is prepared to name freight rates for all overseas trades, both outward and homeward; also through rates from foreign markets via United States or direct to all world's markets in cargo or parcel lots. To meet the cut in transatlantic freight rates made by the British Ministry of Shipping, the U. S. Shipping Board announced on January 27 a reduction of about 66⅔ percent in charges between Atlantic ports and the United Kingdom, France, Italy and Belgium.

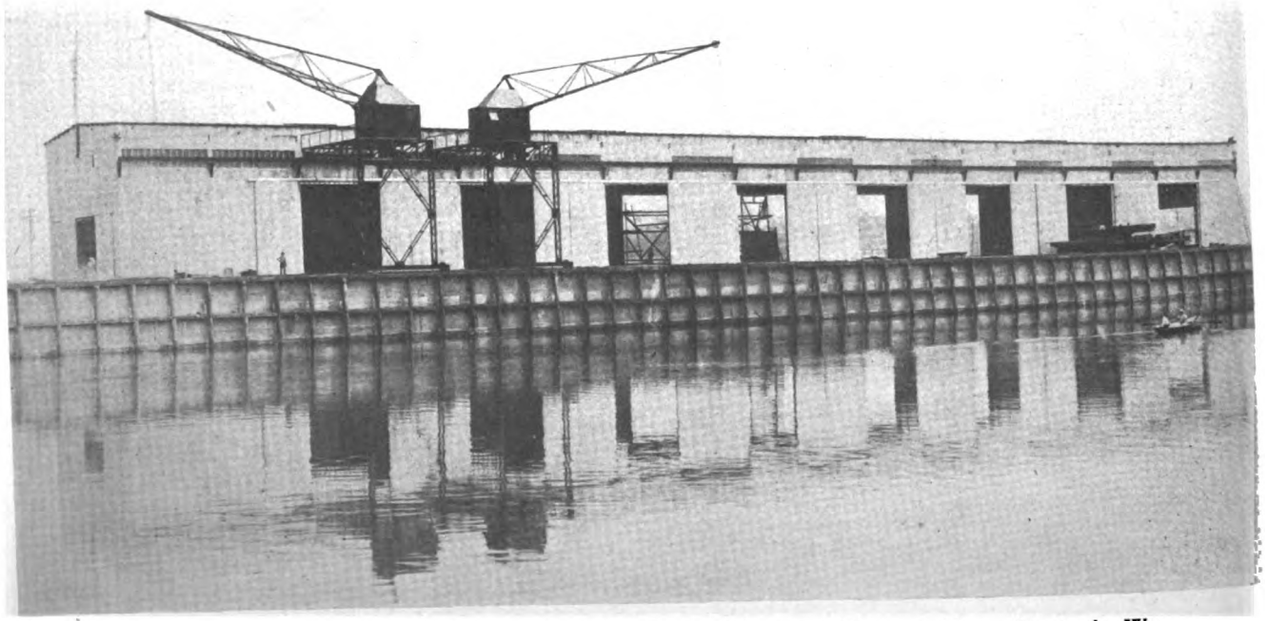
Boston's Dock Improvements

More than thirty options to sell land, buildings and a wharf at Jeffries Point, East Boston, are reported, thereby disclosing an undertaking in that city which, when completed, may rival the Bush Terminals of Brooklyn. Another drydock under way in East Boston, which involves the expenditure of $3,000,000 to $5,000,000, includes an electric railway, which will supply the mile and a half of warehouses along the stretch of port development.

Port Beaumont Terminal

A few years ago there was only a depth of about 7 feet of water to the city of Beaumont, located some 52 miles from the Gulf of Mexico. Here a channel of 26 feet was dredged, and a marine terminal was constructed of modern design and with permanent works, concrete quay walls, which are fireproof, rat proof and decay resisting, coordinated railway tracks between the shed and the edge of the quay, a steel shed and the latest mechanical appliances —the external traveling gantry jib cranes for discharging and loading the ships, and internal cross traveling cranes for assorting, distributing and tiering the freight.

At the end of the first seven months the terminal was earning 4 percent. The following figures, now that the war censorship is removed by the Government, reveal the fact that in the nearly nineteen months, during which time knowledge of the coming and going of vessels was denied the world, 552 steamers sailed into the Beaumont harbor and carried away over 2,000,000 tons of cargo. To foreign ports, 167 steamers carried 661,310 tons, and they brought into Beaumont 73,280 tons. To coastwise harbors, 385 steamers carried 1,075,625 tons, and they brought into the local port 221,875 tons of freight. Such a record has not been equaled under similar conditions at any American port.



View of the Terminal Warehouse Which Handled Large Freight Shipments at Beaumont, Texas, During the War

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NEW SHIPYARDS AND EXTENSION OF EXISTING YARDS

Report of Shipbuilding in Maine and Canada

The Perth Amboy Dry Dock Company is planning for the construction of a large drydock of about 12,000 tons capacity, with shipbuilding and repair facilities at the recently-acquired plant of the Raritan Dry Dock Company. This property has been operated for some time past by James Shewan & Sons, Brooklyn, N. Y., who are now removing the equipment to their Brooklyn works. The new drydock will be of sectional type, having five sections, each 85 feet long and 125 feet wide. The plant will be equipped with machinery for the construction of steel vessels, as well as for the repair of both steel and wooden ships. D. Preacher is chief engineer. The State Board of Commerce and Navigation has recently granted the application of the company for a grant of lands now under water on Staten Island Sound for a consideration of about $25,000. It is understood that this property will be used by the company in connection with its proposed works activity.

IMPROVEMENTS AT THE PHILADELPHIA NAVY YARD

The Navy Department, Washington, D. C., is making substantial progress in construction and improvement work at the Philadelphia, Pa., navy yard. An appropriation of about $20,000,000 has been made available for this work, it being proposed to make this yard one of the largest and most important of the Government plants in this country. Of this appropriation approximately $5,000,000 will be employed for the construction of a large drydock, work upon which is now under way. This dock will be about 210 feet wide by 1,064 feet long, with facilities for handling two vessels at the same time. It will be augmented by a comprehensive railway system and extensive shop facilities. About $3,000,000 will be used for the construction of a six-story machine shop, including a department for handling different features of structural steel work, a forge shop about 300 by 690 feet, a foundry about 490 feet long, a galvanizing plant, a pattern shop, and a number of other structures. This last noted sum will also be utilized, in part, for the construction of two new 900-foot shipways, with cranes and other necessary apparatus.

In addition to the improvements of the Bethlehem Shipbuilding Corporation, Sparrows Point, Md., mentioned in the January issue, that company has commenced the erection of a number of new shop buildings at its works to increase the present operating facilities. The structures will include a one-story addition to the layout shop, about 45 by 425 feet, a one-story extension to the fabricating works, a one-story addition to the electrical shop, and other buildings. New equipment will be installed in the machine shop. It is also planned to equip the present boiler works with new machinery as required.

The Federal Shipbuilding Company, 30 Church street, New York, a subsidiary of the United States Steel Corporation, is planning to construct a large drydock with shop facilities at its shipbuilding plant at Kearny, N. J. The company has arranged to continue the operation of this plant following the completion of Government contracts, and it is understood that a number of all-steel vessels will be built for the parent organization. The new drydock will be located on property recently acquired on the Jersey City side of the Hackensack River, comprising about 85 acres of land, while a second strip of land, 90 by 225 feet, near the Lincoln Highway, has also been purchased for works purposes. The present works comprises twelve shipways, on a site embracing about 160 acres of property. Eight vessels have been launched up to the present time, and three completed ships turned over to the Government. The yard is now giving employment to close to 9,000 persons. L. H. Korndorff is general manager.

The Bureau of Yards and Docks, Washington, D. C., is planning for the immediate construction of a new machine shop at the Brooklyn, N. Y., navy yard, to be used for light machine operations and electrical work. The structure will be erected by the Hinkle Iron Company, 534 West Fifty-sixth street, New York. Bids were recently rejected by the Department for the construction of a new locomotive shop at this yard, and it is understood that new quotations will be asked at an early date.

Reports from the New London Ship & Engine Company, New London, Conn., show that work at this plant is still operating at good caapcity. All the skilled machinists will probably be retained indefinitely. Night work and "top speed" gait have necessarily been abandoned.

The Astoria Marine Iron Works, Astoria, Ore., which specializes in marine repair work, plans a number of improvements to its plant, including installation of machinery.

The Skinner & Eddy Corporation, Seattle, are working on plans to build a blacksmith and power house, 100 by 229 feet, to cost $4,500, and a fitting-out shop, 30 by 120 feet, to cost $7,000.

The Marine Repair & Construction Company, Portland, plans to add four shipways to its plant in the near future. It specializes in repairing hulls and rebuilding scows.

J. A. Taylor and associates, Anacortes, Wash., have purchased a site in that city on which will be erected a shipyard and repair plant for small vessels.

The Bureau of Yards and Docks, Navy Department, Washington, has had plans prepared for extensions to the naval station at Lake Denmark, N. J., to cost about $100,000. It is also planning to build an oxy-acetylene works at Charleston, S. C., to consist of main manufacturing plant to cost $25,000, refrigerating plant to cost $100,000, general service building, $25,000, fuse works and other structures.

The Buffalo Dry Dock Company, Ganson street, Buffalo, has filed plans for a one-story pipe-bending shop, 20 by 26 feet.

The North Country Shipbuilding Corporation, Ogdensburg, N. Y., recently organized, with E. J. Burns at the head, is holding in abeyance plans for its proposed new shipbuilding plant to cost about $150,000.

The West Shipbuilding Company, Wilmington, Los Angeles, Cal., is planning to enlarge its yard.

The Spedden Shipbuilding Company, Baltimore, Md., plans the immediate rebuilding of a portion of its shipyard recently destroyed by fire, at a loss said to be $200,000.

The Norfolk-Hampton Roads Dry Dock & Repair Company, Norfolk, Va., is reported to have let a contract to James Stewart & Company, New York, for the construction of a large plant at Lambert's Point, Va., to cost several million dollars.

The Bruce Dry Dock Company, Pensacola, Fla., is planning for a new drydock with ship repair and construction facilities to cost about $500,000.

Arrangements are being completed by the French-American Shipbuilding Company, Los Angeles, Cal., for building a shipyard, consisting of four shipways, with shops, etc., at San Pedro, Los Angeles harbor, for building steel concrete vessels.

The San Diego Shipbuilding & Dry Dock Company, San Diego, Cal., has received permission from the City Council to establish a shipbuilding and repair plant on the tidelands between First and Fourth streets. The project will cost over $100,000. Adam F. Wecklar is president of the company.

The Moore Shipbuilding Company, Oakland, is negotiating for a number of machines. The Union Construction Company, Oakland, is also contemplating the erection of a plant to build marine engines. It is reported that if the company secures the contract which it is seeking it will at once come into the market for about $50,000 worth of machine tools.

A new electric power plant has been begun at the Savannah, Ga., shipbuilding plant of the Foundation Company. This plant is building all-steel vessels of the trawler type for the French Government.

The Mobile Shipbuilding Company, Mobile, Ala., has acquired sixteen more acres of land adjoining its yard, and will build additions to its shops, so as to equip the yard for the construction of steel vessels.

The Union Shipbuilding Company, Fairfield, Md., is said to be planning to spend $2,000,000 in building four covered concrete shipways and other expensive additions to its present plant, with an electric crane installation to operate between the different ways. The company is planning to arrange facilities for the construction of fourteen vessels at one time, and it is said that when the present work is completed the plant will be one of the largest in this part of the country. It is planned to employ about 3,000 men at the works when complete facilities are available. Recent contracts for construction work have been awarded to the Hughes Foulkrod Company, Philadelphia, Pa. The Union Shipbuilding Company is operated by the McClintic-Marshall Company, Pittsburgh.

The Downey Shipbuilding Corporation, of Arlington, Staten Island, which has been announcing for the past month or so its availability for the construction of special steel freighters, proposes to increase its present capacity to 120,000 deadweight tons. The construction of a new two-story building at its

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plant, about 25 by 158 feet, to cost $15,000, is also contemplated.

Extensions and alterations of the machine shop of the Lighthouse Department, United States Government, at Tompkinsville, Staten Island, are in contemplation, which will cost about $45,000.

The City Council, Los Angeles, has approved a bond issue of $4,500,000, for improvements at the city harbor, San Pedro and vicinity, which will include the installation of cranes and other machinery for hoisting, loading and unloading materials and grain elevators.

The Standard Shipbuilding Company has secured from the New Jersey Board of Commerce and Navigation, a tract of land, 1,800 by 590 feet, on the north side of Shooter's Island, where it is expected there will be a further development of the plant. The price was $45,000.

It is reported that application will shortly be made for the construction of a large dry dock at Vancouver, B. C., to cost at least several million dollars, to be developed under the provisions of the Dry Dock Subsidy Act. No formal request has as yet been made for subsidy. It is stated that the drydock is to be built by a combination of Vancouver parties, including the Lyall Shipbuilding Company and the Pacific Construction Company.

The Kill Von Kull Shipbuilding Corporation has been incorporated, and is planning the construction of a shipyard on Staten Island, where it is reported a site has been purchased. The company is represented by Gilbert & Gilbert, 43 Exchange Place, New York.

Maine Yards Forging Ahead

During the year just ended the total tonnage constructed in Maine amounted to 28,000 gross. In Portland alone four wooden steamers have been built by the Cumberland Shipbuilding Company, and six by the Russell Shipbuilding Company, all of the Ferris type, boats of about 3,500 tons deadweight capacity. Several other steamers have been built or are in the process of construction in Portland and the vicinity, and at Sandy Point two hulls are under construction, all for the Emergency Fleet Corporation, with the exception of one small craft that was built at South Portland for the Greek account. In addition to the above, nineteen schooners, aggregating about 16,000 tons net register, have been launched, and a considerable fleet is on the stocks, including several yet to be launched.

A five-masted schooner, the *Jennie Flood Kreger*, in the Frost yard at Belfast, a vessel of 2,200 tons, will probably reach the water by February 1. At Thomaston, the Atlantic Coast Company have already launched two schooners, and are hurrying work on the third. The Texas Steamship Company at Bath, who has thirteen vessels to its credit for last year's efforts, has now on the ways four steel tanker steamers and three motor barge tanks.

The Kelly-Spear Company at Bath is building for the Government two barges of 2,500 tons capacity each, and one of 3,800 tons capacity for the Staples Coal Company. The G. G. Deering Company has a large schooner already well advanced; Percy & Small will have a five-masted schooner of 3,000 tons capacity, which will probably be ready in May. The frame has also arrived for a four-master to be built in the W. T. Donnell yard, now operated by Pendleton Bros., Inc.

Freight rates for long-distance voyages are still high in this locality. Recent charters of schooners carrying lumber to Buenos Ayres rate at $69, $65 and $52.50 per thousand; rates for a schooner carrying lumber from St. John to Barbadoes were at $20.

Canada's Extensive Production

Up to the end of November Canadian shipbuilders had built for Canadian registry during the war 199 sailing vessels of 44,135 gross tons and 160 steel ships of 69,612 gross tons. For the Imperial Munitions Board fifteen ships of 1,440 net tons each and seven of 2,600 net tons were built. The Dominion Government is having forty steel ships built under contract, aggregating 255,250 tons. Two of these have been launched. The total capacity of Canadian yards is 450,000 tons per year.

The National Shipbuilding Company, Goderich, Ontario, is in the market for a radial drill, lathe, air hoist, lift with trolley and a vertical air receiver for the plant.

The Annapolis Shipbuilding Company, Annapolis Royal, N. S., has started work on a repair dock to handle vessels up to 5,000 tons.

The Halifax Shipyards, Ltd., Halifax, N. S., which recently increased its capital stock from $6,000,000 to $10,000,000, is making rapid progress on its new plant. The company has received orders from the Dominion Government for the construction of vessels of 10,500 tons.

Two steel ships to be built by the Nova Scotia Steel & Coal Company, New Glasgow, N. S., for the Dominion Government will be of 2,800 tons each, and plans are being made to construct ships of 5,000 tons as soon as the present contract is completed. This will probably necessitate extensions to the plant and additional equipment.

The Empire Drydock & Contracting Company, Prince Rupert, B. C., plans the erection of car ferry shops at an early date.

$9,870,000 IN NEW SHIP FIRMS DURING DECEMBER

January Incorporations Show Steady Activity

During December twelve shipping and shipbuilding companies, with an aggregate capitalization of $9,870,000, were incorporated, which indicates that although the actual war necessity has passed, interest in shipbuilding and ship operation is still "on the move." These incorporations include:

American Steamer Corp., Del.	$1,000,000
Boston Dry Dock & Construction Co.	1,000,000
Erickson Navigation Co., Del.	250,000
Empire Ship & Dry Dock Corporation, Delaware	1,500,000
International Steam Navigation Co., New York	100,000
Progress - American Steamship Line, Inc., New York	100,000
Russian-American Steamship & Freighting Co., New York	100,000
Schooner Friendship Corporation, New York	50,000
Southland Steamship Co. of Delaware, Del.	5,000,000
Seven Seas Boatbuilders' Corporation, Washington	500,000
West Shipping Co., New York	150,000
Total	$9,870,000

The Graham Shipping Company, of New York, has been incorporated by M. L. Pehlan, L. Barker and P. H. Graham, with a capital of $250,000, to do a custom house brokerage business.

The Los Angeles Pacific Navigation Company has been incorporated, with a capital of $1,000,000, for carrying on commerce between the American Pacific Coast and foreign ports. L. B. Sale, former president of the Chamber of Commerce, will serve as president. Paul Shoup, vice-president of the Southern Pacific, and president of the Pacific Electric, will serve as vice-president. Representatives of the corporation are arranging for the allocation of from three to five ships of the Emergency Fleet Corporation to Los Angeles harbor. The Lakes & Oceanic Barge & Transit Company, Auburn, Me., has been incorporated, with a capital of $100,000, to manufacture barges and vessels. J. A. Pulsifer, F. E. Ludden and Z. D. Abbott, Auburn, are the incorporators.

The Scotia Shipbuilding Company, recently organized to take over the Milton Shipbuilding Company, assumed control of the plant and holdings of that concern at Yarmouth North, December 24.

A new shipbuilding concern to be known as the Duffy, Blinn Company, has just been established at Saulnierville, Digby county, N. S., and will at once start getting the property which they have acquired for a shipyard ready for building operations. The promoters of the company are Capt. John Duffy, who has just returned from several years at sea, and Edward Blinn, who for some years has maintained an enviable record as a spar maker in many Canadian and United States shipyards.

The United Marine Construction Corporation, 15 Whitehall street, New York, has increased its capital from $200,000 to $1,000,000.

The Bankers' & Shippers' Insurance Company of New York is a new firm, with a capital of $1,000,000 and a surplus of $1,500,000, which has been organized to handle marine and fire insurance. The underwriting will be done by an organization to be known as the Maritime Underwriting Agency. Many prominent interests are identified with the organization, among them the Guarantee Trust Company, the du Pont Powder interest, the Chase Securities Corporation, the Barber Steamship Company, and Willcox, Peck & Hughes, insurance brokers.

Roy H. Robinson, 79 West Monroe street, Chicago, is promoting the organization of a company to build a new type of concrete ships at New Orleans.

A new dockyard company is being promoted at Itozaki, on the Inland Sea, in Japan, with a capital of 3,000,000 yen. It is planned to build or manufacture ships, boilers, tools, machines and other goods, and also to salvage or repair steamers. Four docks, each capable of accommodating vessels up to 10,000 tons, are to be constructed.

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Powerful Hammers Useful in the Shipyards

Bradley hammers, which vary in weight from 800 to 13,200 pounds each, and carry heads ranging in size from 15 to 500 pounds, have found their place in the diversified work of the shipyards. These power-driven hammers, built by E. C. Bradley & Son, Inc., of Syracuse and New York, in cushion helve, upright strap, upright helve and compact types, are capable of forging iron, steel and other metals from 5 inches square down, at the rate of 175 to 450 blows per minute

The accompanying illustrations show punches and chisels made by these hammers right from the bar stock and finished to within 0.010 inch of exact size. Hammer punches made in this manner

Fig. 1.—The Bradley Hammer

present a harder and denser cutting edge than turned tools, and have the additional merit of being produced without waste of stock, since the excess metal from one operation is completely utilized in the next. A 200-pound Bradley hammer in use at the Fore River Shipbuild-

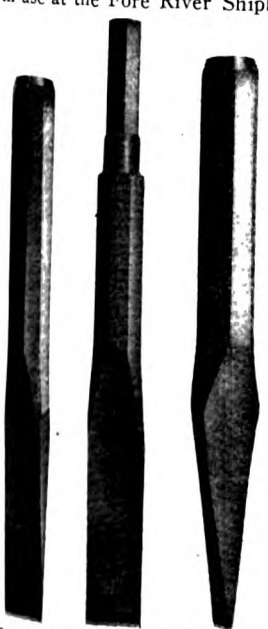


Fig. 2.—Chisels Made in the Shipyards by Bradley Hammers

ing Company, Quincy, Mass., produced 300 wedge-shaped plate steel ship liner forgings per nine and one-half hour day. These parts ranged from 2 to 5 inches in width, with thicknesses up to ⅜ inch.

Pneumatic hammer chisels and calking irons are also quickly fashioned with the Bradley hammer. Except for the grinding of the cutting edge and tempering, the former tools may be completely shaped and finished in the yards. By keeping a water spray on the piece which is finished "black hot" a fine finish can be obtained.

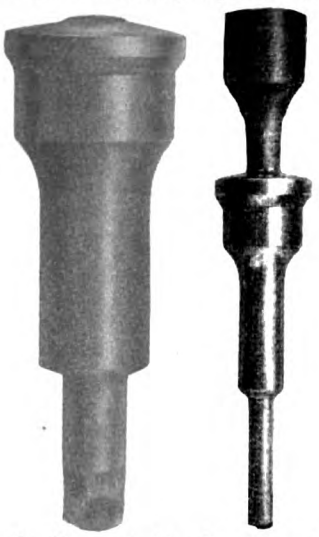


Fig. 3.—Pneumatic Punches Made by Bradley Hammers

Waterproofing Concrete Ships

It is natural that in the development of the concrete ships various methods should be tried out for waterproofing. Among new materials offered, bituminous preparations have been found quite satisfactory for this purpose. In fact, this was specifically mentioned by Rudolf Wig, naval architect, at the annual meeting of the Society of Naval Architects and Marine Engineerings in November, 1918. The ordinary bituminous varnish adheres fairly well to dry cement, and two or three coats of it give a fair covering. This preparation is subsequently coated with spar varnish, so that other paints may be applied, since the ordinary bituminous preparations in use are frequently dissolved by the paints, which are later applied to the surface previously dried.

A new bituminous solution, however, it is claimed, has been discovered by the William Cail Bitmo Company, 18 Broadway, New York, which penetrates to some extent into the actual structure of the concrete. This property of absorption naturally makes it possible for the applied material to obtain a better grip on the concrete and insures an efficient waterproofing, even if the exterior surface covering is chafed off. The process recommended by that company provides for an application of two or three coats of a special solution in quick succession. After this is thoroughly dried a finishing coat of especially prepared solution is applied. This latter coat, the company claims, will not be dissolved by other paints.

Steam Jet Air Pump Patent Changes Hands

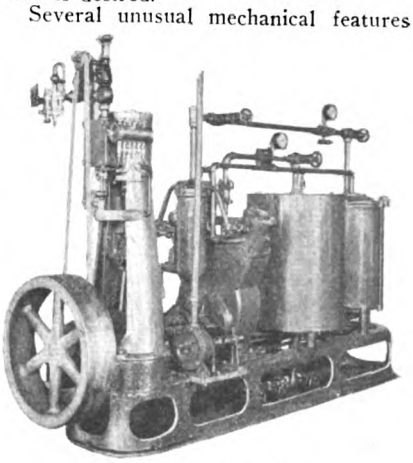
Through the Alien Property Custodian the Wheeler Condenser & Engineering Company, of Carteret, N. J., have obtained from the Schutte & Koerting Company, of Philadelphia, the exclusive right to manufacture and sell steam jet air pumps under Patent No. 968,926, in connection with surface condensers, jet condensers, barometric condensers, vacuum pans and evaporating apparatus. The patent covers the feature of two or more steam jets working in series with a condenser between the jets.

Refrigerating Machine Unit

Recent orders from the Emergency Fleet Corporation and prominent shipbuilding concerns for the refrigerating unit, illustrated herewith, indicate that this machine is meeting with the approval of shipbuilding refrigeration experts.

The advantages of this type are obvious, as the assembly of the engine, compressor, trap, condenser, cooler, circulating pump and liquid receiver, together with the necessary controlling valves, gages, relief valves and piping area upon a single cast iron base economizes time and labor. This method of construction not only conserves space but eliminates much of the usual skilled labor required for the installation on shipboard. This feature is of especial interest to shipbuilders who prefer to make their own installation, although the Refrigeration Engineering Company, of Toledo, Ohio, makers of the new unit, will contract for the complete installation if desired.

Several unusual mechanical features



New Refrigerating Unit

are incorporated in the design of this machine. The compressor is of the two-cylinder type, with valves of large area. A breaker valve is located in the piston head to relieve the vacuum, thus insuring cool cylinder walls. The condenser and cooler are both of the counter-current, submerged coil type, with areas greatly in excess of the capacity required. The positive acting rotary circulating pump is operated by a silent chain, driven direct from the main shaft. The engine is provided with a positive sight-feed oiling system for all bearings, and is of unusual slow speed, for machines of this small size, being operated at 140 to 180 revolutions per minute. A new type scuttle butt of exclusive design is used. It is provided with cast iron heads, and the hand hole is so located that the scuttle may be easily flushed and cleaned.

Since all of the apparatus is assembled upon a single base, the complete outfit can be subjected to an exhaustive refrigeration test under actual operating conditions before shipment.

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New Courses for Naval Architects, Engineers and Ship-Workers

The University of Michigan has introduced an intensive training course in naval architecture. The course, which began January 6, 1919, will run for eleven weeks.

In preparation for the American after-the-war merchant marine, the United States Naval School of Turbine Engineering has been established at the Carnegie Institute of Technology, Pittsburgh, Pa., under direction of naval officers. Several detachments of naval men, who have seen service as engineers of steamers operating reciprocating steam engines, have begun the course.

The Connecticut State Trade School has been conducting courses in shipfitting and blueprint reading as applied to the shipbuilding trade, at 785 Main street, Bridgeport, Conn.

The Young Men's Christian Association has been conducting courses in shipbuilding under T. H. Ascherfield, of the Maryland Shipbuilding Company, in Baltimore, Md.

The United States Government Employment Service at New London, Conn., has opened a course in blueprint reading for ship workers under the direction of Frederick J. Trinder, State director of vocational education. Shipfitting is also being taught to special classes.

Young men, 18 to 35, who have worked in machine shops, have an opportunity to acquire the trade by enlisting in the United States Naval Service for an instruction course at the Government Machinists' School, Charleston, S. C.

Fix Compensation for Ship Management

The operating agreement representing the contract form to be used in the assignment of Government-controlled tonnage to private interests was issued on December 18, 1918. On January 7 the managing agreement was made public. In introducing the latter, J. H. Rosseter, director of operations of the Shipping Board, summarized the text as follows:

The managing agreement defines the rights and duties of the manager as to the managing and husbanding of vessels assigned thereunder. It embraces all ships owned by or under bare boat requisition or charter to the Shipping Board, which have been assigned to private companies to man, provision and maintain in good repair for Government account.

In general, the agent under the operating agreement, is to attend to all those things customarily attended to by a time charterer of a vessel, and the manager under the managing agreement is to attend to those things customarily attended to by the owner of a vessel under time charter. So far as practicable, it is the Board's plan to have the company act as manager and as operating agent of a given vessel. Where this is not done the manager and the operating agent will be expected to work in the closest harmony. The agent will be expected to maintain a first-class operating organization with the requisite staff of freight agents, accountants and executive officers. The manager will be expected to maintain an efficient marine department. The usual and customary duties of a ship's operating and managing agents are to be performed by the agent and the manager, without extra charge, for the compensation specified in the agreement. No additional expense for overhead, fixed charges, services of general employees, or for the usual facilities maintained by well-equipped operating and managing companies are to be charged to the Board.

Geyser Self-Actuated Boiler Cleaner

Simplicity is the basis of the action of the Geyser circulating boiler cleaner, which is designed for use with Scotch marine boilers. Fig. 1 shows the details of the apparatus as installed in a two-furnace Scotch boiler. The principle of operation is as follows: The valve chamber placed at the top of the boiler is provided with three ports, one on each side and one at the top. The ports on the side are fitted with pipes that terminate at their lower end in the bottom of the boiler. The heat which is imparted to all water above the grate line, when steam is being raised in a Scotch boiler, soon raises the temperature of the water. The valve chamber, situated in the position where the water becomes the hottest, absorbs this heat and conducts it to the water contained within the chamber. As the water in the chamber expands and its specific gravity changes, it soon rushes out through the circulator outlet, shown in detail in Figs. 2 and 3; the chamber is continuously refilled from the water drawn by the conductor pipes from the bottom of the boiler.

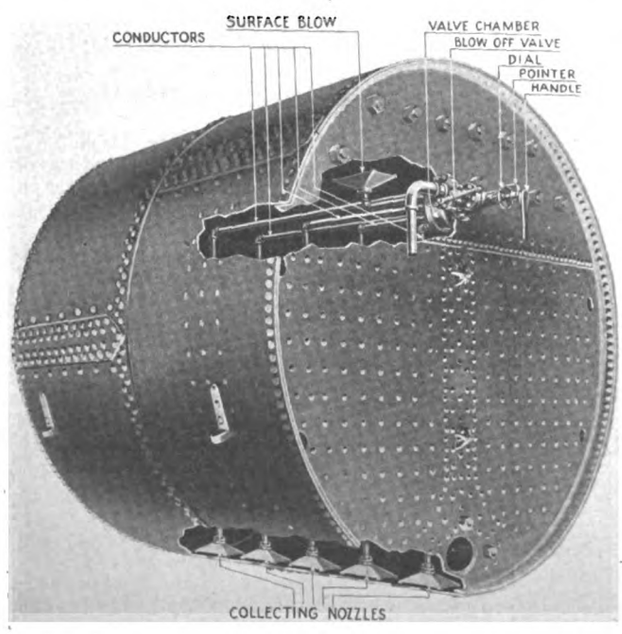
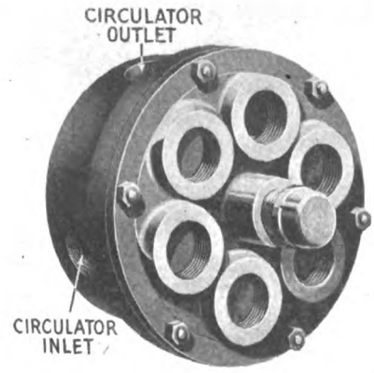
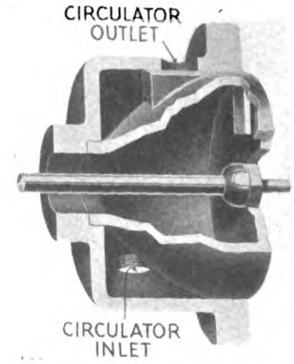


Fig. 1.—Showing Installation of Geyser System in a Scotch Boiler





Figs. 2 and 3.—Showing Exterior and Cross-Sectional View of Valve Chamber

It is obvious, therefore, that a continuous water circulation is assured by the Geyser system as long as the temperatures at the top and bottom of the boiler vary. In actual operation, communication is opened between a collecting nozzle (the turning of the handle on the valve shaft, until the pointer is even with the numbers indicated on the dial plate, determines which nozzle shall be operated) and the main blow-off pipe by adjusting the main blow-off valve. The pressure on the boiler and the efficient shape of the collecting nozzle produce a sweeping current of water, which by actual test is shown to extend approximately 6 inches on each side of the collecting nozzle. When all sediment and scale are removed from that part of the boiler to which the collecting nozzle sprays, the pointer on the dial is turned to operate another nozzle. It is allowed to remain in this position until all solids are removed, when the operation is repeated until a complete revolution is made. In this way all sediment and scale-forming ingredients are removed from the bottom of the boiler.

The valve control is particularly valuable when operating boilers in harbor, river or shoal water, especially when vessels are backing or filling and mud and sediment are being stirred up by the propeller wheel.

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Chairman of Port and Harbor Facilities Commission, E. Carry, Resigns

Announcement was made on January 5 of the resignation of E. Carry, chairman of the Port and Harbor Facilities Commission of the United States Shipping Board. On October 9, 1917, Mr. Carry became director of the division of operations. This department was invaluable in its service of assembling information in regard to the location and daily movements of every merchant vessel operated by the War Department, the Navy Department and the Shipping Board. About June, 1918, he severed his connections with the division of operations to take the chairmanship of the commission from which he has just resigned. He will return at once to the firm of Haskell & Baker Car Company, Inc.

Canadian Railways Plan to Complete Fifty Ships

D. B. Hanna, of the Canadian Northern Railway, has given out that the Government will eventually operate a fleet of at least fifty ships on transatlantic trade in connection with the railways.

National Foreign Trade Council Convention

The National Foreign Trade Council will hold its sixth national foreign trade convention at the Congress Hotel, Chicago, on Thursday, Friday and Saturday, April 24, 25 and 26, 1919. The formal call will be issued shortly by the chairman of the Council, James A. Farrell, president of the United States Steel Corporation.

Twelve Freight Steamships Taken for Transports

Twelve former freight steamships of the American-Hawaiian and Luckenbach lines have been taken over and equipped as transports, with a combined troop-carrying capacity of 19,000 to 20,000 men by the United States army transport service, it has been announced.

Freight Movement Increases

A report of the Exports Control Committee of the Railroad Administration shows a steady increase in the overseas movement of freight since the signing of the armistice, with an incidental accumulation at some Atlantic and Gulf ports. Most of this excess is at the North Atlantic ports, where 5,722 cars were received over December deliveries.

Heyworth, Wood Ship Division Manager, Resigns

The resignation of James O. Heyworth, manager of the wood ship division of the Emergency Fleet Corporation since the fall of 1917, was formally announced on January 19. As has been the case with most of the members resigning from the Board, Mr. Heyworth felt that he was needed in the operation of his private business in Chicago. A summary of the report issued at the time his resignation was accepted appears on another page of this issue.

Continuous Photo-Printing Machine

The illustrations on this page show a continuous photo-printing machine, used in conjunction with an automatic washing and drying machine, both of which were designed and constructed by the C. F. Pease Company, of 213-231 Institute Place, Chicago, Illinois, and

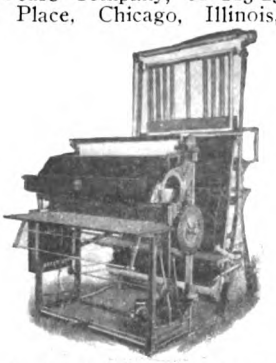

Fig. 1.—Peerless Blue Printing, Washing and Drying Equipment

are sold under the trade name "Peerless." With these machines a single operator can print, wash and dry 100 linear yards of blue prints per hour, during which time the apparatus consumes 7 units of electrical energy, 60 gallons of water and 50 cubic feet of gas. It is, of course, quite possible to use the machine for part of the time only, if such a large output is not required. The operator's time can then be occupied in other ways, and the working costs correspondingly reduced. Prints can also be made on separate sheets of sensitized paper, instead of in continuous rolls, if desired.

Fig. 1 is a front view of the machine and Fig. 2 is a side view, showing the course of the paper through the apparatus. The table from which the tracings are fed into the machine will be seen in Fig. 1, and beneath it are two horizontal spindles which carry rolls of sensitized paper of different widths. The tracings and paper are carried upwards over a cylindrical segment of thick plate-glass by means of an endless canvas belt, best seen in Fig. 2. Springs are provided to keep the belt tight, so as to ensure good contact, and side travel of the belt is prevented by a special device. The belt is driven by a small electric motor, the speed of which is controlled by a rheostat placed on the right-hand side of the machine; both motor and rheostat are clearly shown in Fig. 1. By means of the rheostat the speed of the paper can be varied from 4 inches per minute, which allows sufficient exposure for the slowest negatives and black-line prints up to 6 feet per minute. The exposed paper can be examined immediately after passing the glass segment, so that the speed can be adjusted to give the right exposure before any prints have been spoiled.

In front of the glass is a bank of five arc lamps of the enclosed type, fitted with aluminum reflectors. Each lamp is separately wired and controlled by switches, which are enclosed in a metal box on the left-hand side of the machine, as shown in Fig. 2. The number of lamps employed can thus be varied according to the width of paper being used. The motor switches are also enclosed in the same box, and all the wiring is encased in steel tubing. A small electric fan of the pedestal type is mounted on top of the switch-box. This fan, which can be distinguished in Fig. 2, drives a current of air in a transverse direction through the machine, in order to carry away the heat from the lamps. Fig. 3 shows how easily acces-

Fig. 2.—Showing Rolling-Up Device at Rear of Machine

sible the lamps are for trimming and cleaning, and also illustrates how they may be turned back to facilitate these operations.

After printing, the tracings are delivered into an enameled iron trough in front of the machine, so that the operator can remove them without changing his position. This trough, which can be seen in Fig. 1, also serves to catch the exposed sensitive paper, if the printing machine is used independently of the washing and drying equipment, as is often the case. Usually, however, the exposed paper is passed over a roller at the top of the printing machine, and thence to the washing and drying machine, as shown in Fig. 2. This part of the apparatus is driven, by means of chains and sprocket wheels, from the motor of the printing machine, and in it the paper is first washed by a spray of pure water and afterwards treated by a weak solution of potassium bichromate. This solution is contained in a galvanized tank placed in the base of the machine and clearly visible in Fig. 2. From this tank the solution is circulated by a small

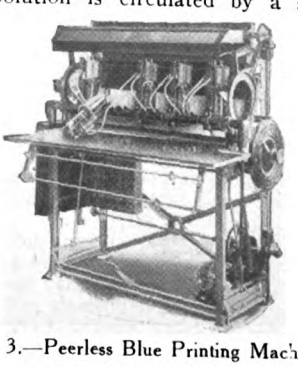

Fig. 3.—Peerless Blue Printing Machine

rotary pump, driven by an electric motor having a vertical shaft, and delivered onto the paper through a flexible pipe; an inspection of Fig. 2 will make the whole arrangement clear. After a further washing with pure water, the paper passes upwards in front of the drying device, over a roller at the top and down at the back of the machine. Here it passes through a system of rollers which carry a series of elastic bands,

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running in opposite directions and forming part of a device for rolling up the finished prints. These are not wound up on a shaft, but the end of the paper, as it descends from the roller at the top of the machine, is formed into a loose roll, and this roll of finished prints, entirely free from wrinkles and distortion, being placed upon the bands, continues to roll itself up automatically until the operator wishes to cut it off and start a new roll.

PERSONALS

COMMISSIONER RAYMOND B. STEVENS, of the Shipping Board, who has represented the United States on the Allied Council since February, 1917, is reported to be returning to America.

WILLIAM I. DONNELLY recently inspected the 10,000-ton drydock being constructed by the Alabama Dry Dock Company for the United States Shipping Board at Mobile.

C. W. COOK, formerly acting head of the Shipping Board Division of Operations, has temporarily rejoined the organization to aid in the speedy charter of ships to private operators as they are released by the Shipping Board.

LEWIS NIXON, vice-president of the Society of Naval Architects and Marine Engineers, and consulting engineer in New York City, has been appointed Superintendent of Public Works of New York State.

EADS JOHNSON, who has served as vice-president of the Carolina Shipbuilding Company while that company was being organized for work for the Shipping Board, has resigned to resume his practice, since the plans and specifications for which he was responsible are now completed.

J. C. VAUGHT, engineer for the American International Shipbuilding Corporation, United States Shipping Board, Emergency Fleet Corporation, has returned to Evansville, Ind., where he will be located with the International Steel & Iron Company.

H. L. BEKKER, director of the Rotterdam Lloyd, who has been in New York several months, has returned to Rotterdam via San Francisco.

MASON G. CHASE, naval architect, has been made a Knight in the Legion of Honor by the French Government for his service to France in her time of need.

MATTHEW C. BRUSH, president of the American International Shipbuilding Corporation, has taken up his duties as executive head of the Hog Island shipyard.

CHRISTOFFER HANNEVIG, the Norwegian shipbuilder and shipowner, has given $100,000 (£20,500) to lay the foundation of a national portrait gallery in the United States similar to that in England, the portraits to be of those men who have formed the driving force in America's efforts in the Great War.

OSCAR R. CAUCHOIS, American representative of French steamship lines in New York, has been made an officer in the Legion of Honor by the French Govment in recognition of his service to France during the war.

W. RUYS has been appointed New York representative of the Rotterdam Lloyd and the Nederland Steamship Company.

CHARLES W. SCHAWB, former director general of the Emergency Fleet Corporation, has received the cross of Chevalier in the French Legion of Honor as a mark of recognition by the French Government for his tangible evidence of friendship toward France during the conflict.

HENRY R. ROBINSON, expert on shipping, cargoes, rates and labor and wages, particularly on the California coast, has been summoned to France by Chairman Hurley. He will have charge of collecting data concerning conditions under which the American merchant marine will finally operate.

A. M. AVERY, who has served as chief clerk to the district supervisor of the United States Shipping Board in the Southern District, from the earliest stages of the shipbuilding programme, has resigned to accept a position with the Terry Shipbuilding Corporation, Savannah.

P. J. ROOSEGAARDE DE BISSCHOP, director for the Java-China-Japan Line, is making investigations concerning Eastern shipping in San Francisco.

E. J. GRIFFITH, who has had charge of the activities of the Emergency Fleet Corporation in obtaining crews for vessels in Northwest ports, has resigned to resume his position with the Pacific Steamship Company.

WALTER A. READ, well known at the New York navy yard, has been appointed chief hull draftsman at the Fore River Shipbuilding Company.

P. L. BJORNSGAARD has resigned his position in the drafting room of the Pusey & Jones Shipbuilding Company.

WILLIAM BINLEY, JR., formerly chief draftsman at the Fore River Shipbuilding Company, has been transferred to the central office of the Bethlehem Shipbuilding Corporation at South Behlehem Pa.

ALLEN ARMITAGE has been made head of both hull and hull equipment drafting rooms at the Pusey & Jones Shipbuilding Company.

B. WILLIAMS, who for the past sixteen years has been with the Newport News Shipbuilding & Dry Dock Company in the hull drafting office, has been appointed president of the Phœbus Foundry Corporation, Phœbus, Va.

CAPT. CHARLES YATES, New York manager of the Shipping Board's Division of Operations, has resigned from his position. He was the first official selected by the late Bernard Baker to assist in organization work.

LOUIS LUCKENBACH, with John A. Gregor, representative of the Bethlehem Steel Corporation, have sailed for Japan to establish a branch of the United States Shipping Board at Kobe, with the intention of building $100,000,000 (£20,500,000) worth of new ships at this port to be paid for by the United States.

T. ASHLEY SPARKS, United States representative of the Cunard Steamship Company, and a director of the company since 1916, has sailed for Europe. Since May, 1918, Mr. Sparks has served as special representative of the British Ministry of Shipping.

A. F. JOHNSON, formerly marine superintendent, Army Transport Service, has taken a position as naval architect at the Fabricated Shipbuilding Corporation, Milwaukee, Wis.

OBITUARY

CAPT. EMERY RICE, commander of the steamship *Mongolia*, the first vessel to sink a German submarine, died at the New York Navy Yard Hospital on January 5, from influenza followed by pneumonia. Captain Rice has had an active sea record since before the beginning of the Spanish-American War.

CLEMENT ACTON GRISCOM, son of the late C. A. Griscom, founder of the Red Star and American Lines, and first president of the International Mercantile Marine, died at his home in New York, December 30, 1918. At the time of his death Mr. Griscom was president of the Griscom-Russel Company and the Audiffren Refrigerating Machine Company, as well as a director of the Empire Trust Company and other enterprises.

ALEXANDER F. BREMMER, a marine engineer and owner of the Boston Engineering Company, died at his home in Wilton, N. H., on January 8.

DANIEL JOHANSON, general manager of the National Independent Fisheries Company, and secretary-treasurer of the Nielson & Kelez Shipbuilding Company, Seattle, Wash., died on January 12 of influenza.

BUSINESS NOTES

Herbert W. Glehill, formerly sales engineer in the Philadelphia office of the Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., has been made district manager of that office with Glenn Rumsey and Leland Woodworth as assistants.

N. L. Snow, formerly vice-president and sales manager of the Terry Steam Turbine Company, of Hartford, Conn., has been elected vice-president and general manager of that company.

I. H. Mills, who has been associated with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., for the past twenty-three years, has resigned to become superintendent of the Sperry Gyroscope Company, Brooklyn, N. Y.

Loyd C. Herring, formerly assistant district sales manager of the apparatus department of the General Electric Company in Boston, has become associated with L. W. Ferdinand & Company, Boston, Mass.

The American Pipe Bending Company, Boston, Mass., is about to open up pipe bending plants in all large cities throughout the country. Each plant will have facilities for turning out from 1,000 to 3,000 bends per day. Deliveries for small orders will be filled on forty-eight hours' notice.

The New York Belting & Packing Company are arranging for extensive additions and alterations to their plant at Passaic, N. J. Several modern reinforced concrete buildings are in the course of construction, consisting of two large manufacturing buildings, each five stories in height, a power house and an enlargement of the office building. By these additions greatly increased facilities will be provided for the manufacture of rubber belting for the transmission of power and for the conveying of ores and coal.

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